

SELECTED
WATER
RESOURCES
ABSTRACTS



VOLUME 3, NUMBER 9
MAY 1, 1970

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



U.S. Department of Commerce, Springfield, Va., 22151

SELECTED WATER RESOURCES ABSTRACTS

**A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior**



**VOLUME 3, NUMBER 9
MAY 1, 1970**

W70-03244 -- W70-03646

DEPARTMENT OF THE INTERIOR

THE UNITED STATES GOVERNMENT IN NATURAL RESOURCES

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.



FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS,
Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography; and Northern Michigan Univ., Marquette.

Edward C. Monahan, and Carl R. Zietlow.
Journal of Geophysical Research, Vol 74, No 28, p 6961-6966, Dec 20, 1969. 6 p, 6 fig, 7 ref.

Descriptors: *Fresh water, *Sea water, *Bubbles, *Laboratory tests, Saline water, Lakes, Oceans, Ocean waves, Analytical techniques, Photography, Simulation analysis, Drops (Fluids), Waves (Water).
Identifiers: *Whitecaps (Water waves).

The bubble spectrum produced by pouring sea water differs from the fresh-water bubble spectrum in that there are relatively more bubbles with radii below 500 microns for sea water. It is therefore concluded that whitecap lifetimes should be greater on the oceans than on the lakes. Confirming laboratory whitecap simulations indicate that salt-water whitecap areas decay almost exponentially with a time constant of 3.85 seconds, whereas the decay constant for fresh-water whitecaps is 2.54 seconds. (Gabriel-USGS)
W70-03451

EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER,
Yale Univ., New Haven, Conn.

For primary bibliographic entry see Field 02C.
W70-03464

02. WATER CYCLE

2A. General

COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY,
Colorado State Univ., Fort Collins.

For primary bibliographic entry see Field 07C.
W70-03256

A NONLINEAR APPROACH TO RUNOFF STUDIES,
College of Engineering, Madras (India).

V. C. Kulkandaiswamy, and C. V. Subramanian.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 10, p 72-79, 1967. 8 p, 5 fig, 1 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Runoff forecasting, Computer models, Streamflow forecasting, Simulation analysis, Rainfall disposition, Unit hydrographs, Hydrograph analysis.
Identifiers: Watershed models.

The process of conversion of rainfall excess into surface runoff is studied by treating drainage basins as lumped systems. The rainfall excess is considered as inflow and the surface runoff as outflow. Making use of the equation of continuity, a differential equation used with field data indicates that the system behavior is nonlinear but can, however, be treated as linear by approximation in the case of major floods. The proposed equation is verified by applying it to observed storms, and the results are found to be very encouraging. This method of approach provides considerable scope for an analytical treatment of rainfall excess-surface runoff relationship. (Knapp-USGS)
W70-03290

AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION,

New South Wales Univ., Kensington (Australia). F. C. Bell.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 12, p 86-93, 1967. 8 p, 4 fig, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Routing, *Mathematical models, Water storage, Infiltration, Evaporation, Runoff, Runoff forecasting.

Identifiers: Watershed models, Infiltration theory.

The so-called 'infiltration theory' and the associated concepts of surface runoff, interflow and base flow have provided a useful but idealized physical basis for simple flood studies. These ideas are not so suitable for more comprehensive studies of watershed behavior when it is necessary to account for the detailed interrelations between evaporation, precipitation and runoff. An alternative system of watershed concepts is therefore suggested, together with a general 'retention theory', which includes infiltration theory as a special case. Retention theory provides for interrelations between hydrologic processes with mathematical expressions of 'watershed condition' and 'watershed function'. The general mathematical forms of these expressions are consistent with current physical knowledge but could be modified, if necessary, by future advances in knowledge. The specific forms of the watershed functions reflect the relevant physical characteristics of individual watersheds. Their degree of approximation or simplification in a particular problem may be governed by the nature of the problem and the amount of information available. (Knapp-USGS)
W70-03291

THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION,

Institute for Water Resources Research, Berlin (East Germany). Alfred Becker.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 13, p 94-102, 1967. 9 p, 4 fig, 2 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, *Water storage, Rainfall disposition, Retention, Infiltration, Soil water, Groundwater, Aquifers, Recharge.

Identifiers: Watershed models.

The total water storage volume of a catchment including storage in soil and aquifers can be replaced in a model by a uniform storage layer covering the whole catchment, with storage characteristics an average of the catchment. For uniform precipitation conditions in the model catchment, threshold concepts are approximately valid. Even if rainfall distribution is known for all possible conditions, rainfall-runoff-relations generally deviate from the model catchment relations. These deviations are a measure of the hydrological inhomogeneity of the natural catchments. (Knapp-USGS)
W70-03292

FLOOD FORECASTING IN THE RIVER KITAKAMI,

Tohoku Univ., Sendai (Japan). Hydraulic Engineering Lab. Toshio Iwasaki.

French synopsis included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 14, p 103-112, 1967. 10 p, 6 fig.

Descriptors: *Rainfall-runoff relationships, *Flood forecasting, *Model studies, *Analog models, Analog computers, Rainfall disposition, Routing, Hydrograph analysis, Unit hydrographs, Runoff forecasting.

Identifiers: *Japan, Kitakami River, Watershed models.

Most river reaches in Japan are very short compared to those on continents, and high stages appear at their downstream ends during rainfall. Flood forecasting is difficult because runoff must be estimated simultaneously with computation of the unsteady flow running down the river. Analog simulations were specially designed for this purpose. Precipitation data are recorded on punched tape. Photoelectric methods are used to convert the digital data to analog, and lag circuits of the second order are used to calculate runoff by the unit graph method. Flood forecasting was successful in the River Kitakami, and the method may be used for the flood prediction of other rivers. Total time for the calculation was only three minutes. (Knapp-USGS)
W70-03293

FLOW ROUTING BY DIRECT INTEGRATION METHOD,

Department of Energy, Mines and Resources, Toronto (Ontario). Conservation Authorities Branch.

For primary bibliographic entry see Field 02E.

W70-03294

COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

For primary bibliographic entry see Field 02E.

W70-03295

THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,

Stanford Univ., Calif. Dept. of Civil Engineering. Dale D. Huff, and Paul Kruger.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 17, p 128-135, 1967. 8 p, 15 ref. USPHS Grant ES-00047-03.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, *Runoff forecasting, *Synthetic hydrology, Tracers, Strontium radioisotopes, Cesium, Simulation analysis, Hydrograph analysis, Aerosols, Precipitation (Atmospheric). Identifiers: Watershed model, Cesium radioisotopes.

The Stanford Watershed Model IV has been successful in reproducing the continuous outflow hydrographs in over 40 watersheds by digital simulation of the hydrologic processes. Additions to this Model are being made to include the simulation of the transport of specific radioactive aerosols through the watershed. Subroutines for the IBM 7090 computer program are being developed to evaluate the chemical and physical parameters in the elements of hydrologic aerosol transport. A discussion of the important transport element subroutines, which include deposition, vegetal interception, soil surface interactions, and channel transport, is given for the important radiotracer elements strontium and cesium. (Knapp-USGS)
W70-03296

A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

Petar Todorovic, and Vujica Yevjevich.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 39, p 298-305, 1967. 8 p, 3 fig, 7 ref.

Field 02—WATER CYCLE

Group 2A—General

Descriptors: *Rainfall disposition, *Groundwater movement, *Bed load, *Mathematical models, *Stochastic processes, Probability, Markov processes, Synthetic hydrology, Statistical methods, Statistical models.

Identifiers: Hydrologic models (Statistical).

A particular stochastic process of nondecreasing sample functions is adjusted for application in hydrology. Three examples are discussed regarding such applications; namely, the rainfall phenomena, the groundwater diffusion problem and the movement of bedload particles. Because all three phenomena may be conceived as discrete steps of one-directional random movement of a point along a straight line, these applications meet the basic conditions for the stochastic process described. (Knapp-USGS)
W70-03301

VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS,

Waterloo Univ (Ontario).

For primary bibliographic entry see Field 07C.

W70-03303

RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING,

Gruzinskii Politekhnicheskii Institut, Tiflis (USSR).

G. G. Svanidze.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 43, p 329-336, 1967. 8 p, 15 ref.

Descriptors: *Runoff forecasting, *Streamflow forecasting, *Statistical methods, Probability, Markov processes, Stochastic processes, Mathematical models, Statistical models, Simulation analysis, Synthetic hydrology.

Identifiers: Watershed models.

River runoff is viewed as a stochastic process, the only realization of which is an observed hydrological series. Presented are some possible mathematical models of runoff with discrete and with continuous time. A method is here set forth for the modelling of hydrological series with the aid of orthogonal expansions. This has some advantages over the existing methods of modelling; in particular, it enables an immediate setting up of continuous realizations of runoff, under the assumption that the process is not a Markovian one. (Knapp-USGS)
W70-03304

A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES,

Kyoto Univ. (Japan). Disasters Prevention Research Inst.

Mutsumi Kadoya.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 44, p 337-343, 1967. 7 p, 8 fig, 3 ref.

Descriptors: *Streamflow forecasting, *Rainfall-runoff relationships, *Statistical methods, Mathematical models, Statistical models, Stochastic processes, Markov processes, Simulation analysis, Synthetic hydrology, Time series analysis.

Identifiers: Watershed models.

A serious problem for hydraulic planning is determination of whether or not, in the sequence of hydrologic quantities, cyclic or periodic variations exist. The general character of the long-term variations in the sequences of annual sum and annual maximum of daily precipitation and of river runoff in Japan are examined using the technique of overlapping moving average. The secular variations of hydrologic quantities of short duration, such as the annual maximum daily precipitation, seem to be more random than those having the average

characteristics of long duration, such as the annual sum of precipitation. The possibility or the limit of stochastic prediction for the sequential variations of hydrologic quantities by the technique of time series analysis is considered. Because the possibility of prediction is governed mainly by the power of the singular variations in the sequence, the simulation technique should be adopted in order to involve the character of secular variations of hydrologic quantities in hydraulic planning. (Knapp-USGS)
W70-03305

EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL,

Clemson Univ., S.C. Water Resources Research Inst.

James T. Ligon, Albert G. Law, and Donald H. Higgins.

Available from the Clearinghouse as PB-189 290, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, South Carolina Water Resources Research Institute, Clemson Univ, Report No. 12, Nov 1969. 120 p, 26 fig, 1 plate, 4 tab, 12 ref, 5 append. OWRR Project A-010-SC.

Descriptors: *Hydrologic models, *Simulation, Soil moisture, Groundwater, Runoff, Infiltration, Evapotranspiration.

Identifiers: *Piedmont, *Stanford Watershed Model, Digital computer model.

A detailed analysis of the University of Kentucky version of the Stanford Watershed Model III is reported along with comparisons with Model IV. During the analysis certain errors were noted and corrected, and the source and validity of certain hydrologic functions were investigated. The model was tested on a 561-acre Piedmont watershed located near Clemson, South Carolina, for which several years of extensive hydrologic data were available. Model parameters were varied to observe their effects on model output and attempts were made to optimize these parameters. The model simulated annual stream flows quite well, monthly flows reasonably well, but daily flows and individual storm hydrographs were less satisfactory. The model as presently constituted does not incorporate a satisfactory soil moisture-groundwater relationship for this Piedmont watershed. Future studies will be concerned with improved simulation of this relationship.
W70-03436

ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS,

Kyoto Univ. (Japan). Disasters Prevention Research Inst.

Mutsumi Kadoya.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 24, p 177-184, 1967. 8 p, 7 fig, 6 ref.

Descriptors: *Natural recharge, *Surface-groundwater relationships, *Infiltration, Groundwater movement, Soil water movement, Evapotranspiration, Water loss, Runoff, Rainfall-runoff relationships.

Identifiers: Japan.

A theoretical method for the estimation of the groundwater flow and the rainfall loss in a small mountain stream is described. There is a simple relation between the infiltration capacity and the soil-moisture ratio in the surface layer of a drainage basin, defined by the saturated soil-moisture ratio, the hygroscopic coefficient, and the upper and lower limits of infiltration capacity. The equation derived for the infiltration capacity can be used for the recharge capacity. Recharge of groundwater occurs only if the soil-moisture ratio in the surface layer equals or exceeds the maximum capillary water capacity. A simple relation exists between the evapotranspiration and the soil-moisture ratio in the surface layer of the basin. The depth of an

imaginary surface layer related to the recharge capacity equals the actual depth related to evapotranspiration. (Knapp-USGS)
W70-03489

PALEOHYDROLOGY: APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST,

Colorado State Univ., Fort Collins. Dept. of Geology, and Geological Survey, Fort Collins, Colo.

S. A. Schumm.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 25, p 185-193, 1967. 9 p, 4 fig, 1 tab, 22 ref.

Descriptors: *Paleohydrology, *Rivers, *Runoff, *Sedimentation, Regime, Rainfall, Vegetation effects, Floods, Sediment yield, Surface waters, Weathering, Erosion, Climates, Weather.

The relationships between precipitation, temperature, runoff, and sediment yield can be used to theorize on the manner in which ancient rivers responded to modification of their hydrologic regimen due to climate change. During the last few million years of earth history, vegetation was much as it is today within a given climatic environment, and the hydrologic relationships of the present can be applied directly to this portion of geologic time. However, when the surface of the earth was a phytological desert, that is, before the appearance of land vegetation and also during the colonization of the earth's surface by evolving vegetation, the character of the surface water portion of the hydrologic cycle would have been very different from that of the present. Great floods must have been more frequent with sediment yield rates being limited only by the erodibility and weathering characteristics of rocks. It is suggested herein that the hydrologist can contribute to a better understanding of these past environments and, thereby, to the solution of some puzzling geologic problems. (Knapp-USGS)
W70-03490

THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW,

Melbourne Univ., Parkville (Australia). Dept. of Agricultural Engineering.

G. A. Jobling, and A. K. Turner.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 27, p 203-210, 1967. 8 p, 7 fig, 3 ref.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Model studies, *Hydraulic models, *Simulated rainfall, Simulation analysis, Artificial precipitation, Rainfall simulators, Runoff forecasting, Routing.

Identifiers: Watershed models.

'Overland flow' over natural surfaces is unsteady and spatially varied, due to both rainfall and infiltration. Most experimental work to date has been done using impermeable surfaces, the effects of time-dependent infiltration being ignored. Research into flows over natural surfaces is time consuming and the results are difficult to interpret at this stage in our knowledge of such flows. A method of simulating infiltration is described which enables experimental work to be undertaken in a tilting flume. The system produces a time-dependent decay in simulated infiltration, and can be described by an equation of the form used by Kostiakov. Since the two parameters involved can be readily altered, the system provides a means of simulating a range of field surfaces. Some initial results using the method are described. (Knapp-USGS)
W70-03492

THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,

Cornell Univ. Ithaca, N.Y.

For primary bibliographic entry see Field 02G.

W70-03495

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).
Zdenek Kos.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 37, p 283-289, 1967. 7 p, 4 ref.

Descriptors: *Streamflow forecasting, *Water management (Applied), *Mathematical models, *Probability, *Stochastic processes, Markov processes, Reservoir yield, Multiple-purpose reservoirs.
Identifiers: *Watershed planning.

Stochastic hydrology is successful in forecasting streamflow, especially with the aid of electronic digital computers. The method of generation of synthetic hydrologic records used in Czechoslovakia is described. Simulation studies are made for yearly flows in order to determine the overyear component of active reservoir capacity required for a specified level of draft and for monthly flows to determine its seasonal component and for the design of multiunit, multipurpose water resources systems. (Knapp-USGS)
W70-03496

SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.

Theodorus H. Hufen, Robert A. Duce, and L. Stephen Lau.

Available from the Clearinghouse as PB-189 406, \$3.00 in paper copy, \$0.65 in microfiche. Technical Report No 34, Completion Report, Hawaii Water Resources Research Center, Nov 1969. 32 p. OWRR Project A-016-HI.

Descriptors: *Tritium, *Hawaii, Rainwater, Groundwater.
Identifiers: *Oahu (Hawaii).

An analysis was made of the tritium content of samples from various sources of surface and subsurface waters of the island of Oahu. Twenty rainwater samples collected from various rain gauges located on the Koolau Range over a period of four months showed an activity between 16.3 and 28.2 tritium units. Samples from four streams in the Pearl Harbor area ranged from 14.5 to 21.3 tritium units, while samples from two springs and five wells in this same area all showed an activity below 5 tritium units. The instrumentation consisted of an electrolysis enrichment apparatus, a vacuum distillation unit and a liquid scintillation counter. A detailed description is given of the various parts of the electrolysis apparatus and the vacuum distillation unit. Both the enrichment and counting procedures are reviewed as well as the calibration of these systems.
W70-03613

A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
For primary bibliographic entry see Field 02B.
W70-03645

2B. Precipitation

A RAINFALL RATE SENSOR,
Coast and Geodetic Survey, Rockville, Md.
For primary bibliographic entry see Field 07B.
W70-03363

GENERALIZING DRY-DAY FREQUENCY DATA,

Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
David M. Hershfield.
Journal of American Water Works Association, Vol 62, No 1, p 51-54, Jan 1970. 4 p, 6 fig, 4 tab, 5 ref.

Descriptors: *Probability, *Droughts, *Precipitation (Atmospheric), Weather, Climates, Forecasting, Statistical methods, Weather forecasting, Estimating, Frequency analysis.
Identifiers: Dry-day sequences, Dry-day forecasting.

A statistical procedure is presented for calculating the probability of dry-day sequences up to 20 days in length. Mean annual dry period frequencies, probabilities, and lengths in the eastern and central U. S. are shown on maps. The procedure requires information on the mean annual number of days with precipitation above a selected threshold. Use of the cumulative form of the geometric distribution as given will provide the probability, P, of obtaining a dry period of a particular length, k. For rarer return periods (longer dry periods), say, greater than 20 days, the extreme-value procedure appears to be satisfactory. (Knapp-USGS)
W70-03441

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS,

Texas A and M Univ., College Station. Dept. of Meteorology.

Walter K. Henry, John F. Griffiths, L. Glen Cobb, and David Morris.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, Oct 1967. 169 p, 58 fig. Contract No DA 28-043 AMC-2313 (E), DA Proj No 1VO-14501-B-53A-09-04.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, Climatology, Precipitation (Atmospheric), Storms, Synoptic analysis, Tropical cyclones, Weather.
Identifiers: *Tropical rainfall, South America.

The rainfall pattern, the seasonal changes of rainfall, the variation of rainfall, and an analysis of the areal coefficient of association of rainfall were studied in Guayana and Surinam. Some movement of rains to the south were observed in Colombia (about 20 miles per day). A study of daily rainfall in interior Colombia included establishing the size and location of principle mesoscale systems on individual days. The method of extreme value distribution has been applied to some rainfall data from Venezuela. The analysis shows that in nearly all cases it is possible to use the asymptotic distribution. A method of areal presentation is derived and presented. The general problem of rainfall trends is investigated by the use of the single-runs test and simple linear regression. No significant trends for stations in Guayana and Surinam were found. Excellent correlation exists between occurrences of high sea temperatures in Peru (El Nino phenomena) and excessive rainfall. A zonification according to seasonal distribution of rainfall provides information about existing regions of uniform distribution and the approximate position of the intertropical convergence zone across Western Colombia. Associations of annual rainfall were generally low, with only a few limited areas displaying moderate to high association values. (Knapp-USGS)
W70-03479

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM,

Texas A and M Univ., College Station. Dept. of Meteorology.
Walter K. Henry.

US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 1-13, Oct 1967. 13 p, 7 fig.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.
Identifiers: *Guayana, *Tropical rainfall.

The rainfall patterns of Guayana and Surinam are complex. However, the terrain is not as much of a cause of the rainfall variation as in other areas. The variations from station to station are pronounced as shown by all criteria. Also, the synoptic feature which causes the December rains along the coast does not extend its effects more than 200 miles inland. (Knapp-USGS)
W70-03480

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA,
Texas A and M Univ., College Station. Dept. of Meteorology.

Walter K. Henry.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 14-20, Oct 1967. 7 p, 3 fig.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.
Identifiers: *Colombia, *Tropical rainfall.

An attempt to trace the movements of rainstorms in Colombia by using three-day running totals of daily rain was partially successful. Rainy periods were well identified. In a few cases, movement toward the south was identified and a rate of about 20 miles a day established. This rate is about the same as was established by previous investigations. From the differing amounts of rainfall, it is apparent that the systems were not active at all times. (Knapp-USGS)
W70-03481

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART C. DAILY RAINFALL IN INTERIOR COLOMBIA,
Texas A and M Univ., College Station. Dept. of Meteorology.

Walter K. Henry.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 21-37, Oct 1967. 17 p, 11 fig, 1 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather, Topography.
Identifiers: *Colombia, *Tropical rainfall.

The rainfall patterns in interior Colombia are greatly influenced by the rugged terrain. A study of daily rainfall was made in the month of April 1962. April is the beginning of the rainy season. It was selected so that the arrival of the rains could be observed. The entire area had only scattered light showers between the 7th and the 18th. From the 18th to the end of the month there was only one day which at least half the stations did not receive some rain. On the 21st, which was the雨iest day, 12 stations did not receive any rain. The stations in wide valleys receive much less rain than do those on the mountain sides. In narrow valleys the system is large enough to extend over, or even across, the valley. Mesoscale systems are smaller on the Bogota plateau than in the lowlands. If a systematic movement of mesoscale systems exist in the mountain areas of Colombia, it has not yet been identified. (Knapp-USGS)
W70-03482

Field 02—WATER CYCLE

Group 2B—Precipitation

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART D. NORMALITY OF RAINFALL DISTRIBUTIONS,

Texas A and M Univ., College Station. Dept. of Meteorology.

John F. Griffiths.

US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 38-67, Oct 1967. 30 p, 4 fig, 3 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather, Topography.

Identifiers: *Guayana, *Surinam, *French Guiana, Tropical rainfall.

About 90% of the station rainfall data in Guayana, Surinam, and French Guiana exhibit a square-root-normal distribution while about the same percentage exhibit a normal distribution of annual amounts. Areal analysis of non-normally distributed station-months may provide important clues to regions which should receive special synoptic studies. In general, normality (of absolute numbers or their square roots) of the data may be assumed but there are groups of abnormal stations near New Amsterdam and Paramaribo. (Knapp-USGS)

W70-03483

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART E. EXTREME VALUE ANALYSIS IN VENEZUELA,

Texas A and M Univ., College Station. Dept. of Meteorology.

John F. Griffiths.

US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 68-81, Oct 1967. 14 p, 8 fig, 1 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather, Topography.

Identifiers: *Venezuela, *Extreme value analysis, Tropical rainfall.

An extreme value analysis was made of the records from 15 stations in Venezuela. For these stations the highest amount of daily rainfall recorded in each month for the whole period of record was extracted. Some of the extremely high values are rather dubious; comparison with neighboring stations gives rise to a suspicion that the value given for one day is actually a composite of many days. For each month for each station, plots were made of the resulting points on extreme probability graph paper. Lines of best fit were then drawn for these points and from the resulting line the values of the precipitation corresponding to the 0.30 and 0.90 probability levels were extracted. Extreme (30% and 90%) values are tabulated and shown by contour maps. (Knapp-USGS)

W70-03484

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART F. TRENDS IN THE RAINFALL,

Texas A and M Univ., College Station. Dept. of Meteorology.

John F. Griffiths.

US Army Electronics Command Research and Development Technical Report ECOM-2313-S2, p 82-86, Oct 1967. 5 p, 3 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.

Identifiers: *Venezuela, *Tropical rainfall.

Swed-Eisenhart and linear regression analyses were used to test for long term precipitation and climatic trends in the Guianas. Except for 2 stations with possible trends, no trends could be found. For Guyana and Surinam, no trends are shown by the statistical analyses. (Knapp-USGS)

W70-03485

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART H. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA,

Texas A and M Univ., College Station. Dept. of Meteorology.

David G. Morris.

US Army Electronics Command Research and Development Technical Report ECOM-2313-S2, p 104-155, Oct 1967. 52 p, 26 fig, 1 tab, 16 ref, append.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.

Identifiers: *Colombia, *Tropical rainfall.

The seasonal distribution of rainfall is uniform within broad, well defined areas of Western Colombia. The map of mean annual rainfall shows definite synoptic-scale patterns in some areas, with the most significant being the Pacific western coast and the eastward intrusion across the northern terminus of the Cordilleras. The variability of annual totals is generally greatest in higher, drier elevations, with lower areas showing standard deviations on the order of 200 mm and 400 mm. Rainfall variability increases or decreases greatly over small distances in rugged terrain. Generally, there is little association in the annual rainfall except in small areas. Relatively small changes in topography greatly alter the rainfall patterns. Rainfall patterns east of the Cordillera Occidental are not associated with the rains of the Pacific west coast. (Knapp-USGS)

W70-03486

SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII,

Hawaii Univ., Honolulu. Water Resources Research Center.

For primary bibliographic entry see Field 02A.

W70-03613

A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO,

Idaho Univ., Moscow. Water Resources Research Inst.

Richard L. Day.

Available from the Clearinghouse as PB-189 402, \$3.00 in paper copy, \$0.65 in microfiche. Idaho Univ Water Resources Res Inst Tech Completion Rep, Sept 1968. 68 p, 30 fig, 3 tab, 1 append. OWRR Proj No A-012-IDA.

Descriptors: *Climatology, *Microclimatology, *Micrometeorology, *Idaho, *Precipitation (Atmospheric), Temperature, Humidity, Meteorology, Storms, Topography, Weather, Weather data, Data collections.

Identifiers: *Snake River Canyon (Idaho), Clearwater Mountains (Idaho).

Temperature and relative humidity records have been kept at a maximum of 18 sites, and precipitation records at 8 sites, along a 75-mile profile between Wawawai, Washington, elevation 675 ft in the Snake River Canyon, and Crater Peak, elevation 6400 ft in the Clearwater Mountains, Idaho. The most distinctive microclimatic feature is the extreme development of nocturnal temperature inversions during summer and early autumn. Mean inversions between non-contiguous hilltops and

bottomlands may reach 20 to 30 deg. Greatest recorded on a specific day has been 42 deg. Mean temperatures, length of frost-free season, nocturnal relative humidities, natural vegetation, and land use are all strongly influenced by these inversions. None of the 6 official Weather Bureau stations in the vicinity of the profile is located to show these inversions. Diurnal temperature and relative humidity patterns differ greatly at individual sites along the profile and are analyzed and compared. Precipitation normally varies by a factor of at least 3 1/2 along the profile, but may reach several times this value during individual months. Maximum snow depths range from none at Wawawai to 14 ft at Lost Lake near Crater Peak during specific snow seasons. (Knapp-USGS)

W70-03645

2C. Snow, Ice, and Frost

VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA,

Centre National de la Recherche Scientifique, St. Cloud (France).

C. Loriois, L. Merlinat, and R. Hagemann.

Journal of Geophysical Research, Vol 74, No 28, p 7027-7031, Dec 20, 1969. 5 p, 2 fig, 1 tab, 10 ref.

Descriptors: *Deuterium, *Precipitation (Atmospheric), *Antarctic, *Firm, Air temperature, Sampling, Mapping, Stations, Snow, Altitude, Coasts, Meteorological data.

Identifiers: Antarctica.

Firm samples taken at the Adelie Coast, Victoria Land, and Marie Byrd Land of Antarctica were analyzed for their deuterium content and the results are tabulated. The mean isotopic content of snow samples is generally associated with the mean annual temperature prevailing at the place where precipitation occurs. (Gabriel-USGS)

W70-03461

EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER,

Yale Univ., New Haven, Conn.

Theodore D. Foster.

Journal of Geophysical Research, Vol 74, No 28, p 6967-6974, Dec 20, 1969. 8 p, 9 fig, 1 tab, 9 ref. ONR Contract No N00014-67-A-0097-0001.

Descriptors: *Sea water, *Salinity, *Convection, *Freezing, *Density currents, Laboratory tests, Mathematical studies, Thermal conductivity, Diffusion, Mixing, Analytic techniques, Instrumentation, Cooling, Water temperature, Currents (Water), Photography, Eddies.

Identifiers: Haline convection.

Laboratory experiments were performed in which sea water was frozen from above at controlled rates. The resulting haline convection was observed by using a schlieren optical system. Salinity of the sea water was varied from about 20 to 35 parts per thousand. Freezing rates up to about 0.00015 g/sq cm sec were used. The resultant salt fluxes varied from about 0.0000002 to 0.000002 g/sq cm sec. The haline convection took the form of long vertical filaments with a horizontal spacing of 0.2 to 0.3 cm, in good agreement with the predictions of linear theory. (Gabriel-USGS)

W70-03464

2D. Evaporation and Transpiration

ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION,

Wisconsin Univ., Madison. Dept. of Soil Science.

T. A. Black, C. B. Tanner, and W. R. Gardner.

Available from the Clearinghouse as PB-184 791, \$3.00 in paper copy, \$0.65 in mress Report to Environmental Science Services Administration from

Streamflow and Runoff—Group 2E

Wisconsin University, May 1969. 42 p, 9 fig, 1 tab, 28 ref. ESSA Grant E-287-68 (G).

Descriptors: *Evapotranspiration, *Water loss, *Drainage, Water balance, Hydrologic budget, Darcys law, Infiltration, Evaporation, Runoff, Lysimeters, Soil-water-plant relationships, Soil water movement, Water storage.

Identifiers: Potential evapotranspiration, Soil water evaporation.

Water loss from soils supporting vegetation is due to either evapotranspiration or drainage. Means of calculating both of these components of the hydrologic balance were investigated using primary climate, soil, and plant parameters. Evapotranspiration was found by treating separately the processes of transpiration from vegetation and evaporation from the soil. The model was tested on a snap bean crop in which two drying cycles restricted evapotranspiration severely. The calculated evapotranspiration was 102 mm whereas 98 mm was measured. As much as 30% relative error was found when the soil was dry, but the absolute error was only 0.3 mm. Inaccuracy was due mainly to inaccurate estimates of evaporation from the soil. Drainage from the root zone of the snap beans grown on a sandy soil was measured in three ways: by Darcy's law, by a lysimeter, and by the hydrologic balance. Darcy's law gave a 13% higher estimate than the other two methods, which agreed well with each other. (Knapp-USGS)
W70-03449

2E. Streamflow and Runoff

UNIVERSAL FORMULA FOR UNIFORM FLOW,
Tennessee Valley Authority, Norris. Engineering Lab.
For primary bibliographic entry see Field 08B.
W70-03248

LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,
Geological Survey, Washington, D.C.

Charles W. Carlton.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 21-31, Dec 1969. 11 p, 4 fig, 4 ref.

Descriptors: *Channel morphology, *Profiles, *Mississippi River, *Missouri River, *Ohio River, Geomorphology, Erosion, Sedimentation, Regime; Terracing, Channels, Beds.
Identifiers: River profiles.

Study of longitudinal stream profiles of rivers of the Midcontinent (rivers tributary to the Mississippi) and Atlantic and East Gulf Slopes has revealed five types of longitudinal profiles: (1) Overall concave-upward profiles with or without long constant slope segments; (2) convex upward (the Missouri River has a profile that has a constant slope for its lower 560 miles and then is convex upward to a point beyond the Yellowstone River junction); (3) concave-upward irregular, ungraded, low-gradient profiles (Ohio and Tennessee Rivers); (4) irregular unsegmented and steep profiles, such as shown by the Delaware and Savannah-Tugaloo Rivers; and (5) irregular ungraded, steep-gradient profiles that are concave-upward in the upstream reaches and downstream convex-upward, for example, on most of the Atlantic Slope and East Gulf Slope Rivers above the Fall Line. Constant slope profiles occur where the last type of rivers flow across relatively weak Coastal Plain sediments and also inland on the Coosa and Oostanaula-Conasauga Rivers. The profile characteristics of the Atlantic and East Gulf streams lend support to the hypothesis of multiple erosion cycles in the Appalachians. (Knapp-USGS)
W70-03255

FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.

Corps of Engineers, Buffalo, N.Y.
For primary bibliographic entry see Field 04A.
W70-03261

REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA,

Pittsburgh Univ., Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07C.
W70-03263

FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.

Corps of Engineers, Seattle, Wash.
For primary bibliographic entry see Field 04A.
W70-03272

FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.

Corps of Engineers, Jacksonville, Fla.
For primary bibliographic entry see Field 04A.
W70-03273

MINERAL AND WATER RESOURCES OF ARIZONA: PART 2. WATER RESOURCES; AND PART 3. WATER RESOURCE DEVELOPMENT,

Geological Survey, Tucson, Ariz.; and Bureau of Reclamation, Phoenix, Ariz.
J. J. Ligner, Natalie D. White, L. R. Kister, and M. E. Moss.

Report available for sale by Arizona State Bur of Mines, Ariz Univ, Tucson, Ariz. Price \$3.00. Arizona State Bureau of Mines Bulletin 180, p 469-638, 1969. 170 p, 34 fig, 38 tab, 108 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Water supply, *Arizona, Water yield, Water utilization, Irrigation water, Overdraft, Water levels, Streamflow, Water level fluctuations, Withdrawal, Reservoirs, Reservoir yield, Hydroelectric power, Data collections, Hydrologic data, Water rights.
Identifiers: Water availability (Ariz).

Factual information about Arizona's present water supplies and supplies available for future exploitation is compiled in a summary of the State's mineral and water resources. The physical environment and water provinces of the State are described, followed by descriptions of the water resources under each respective water province, by province subdivision, or area. Summary information is presented in maps, graphs, and tables. Also included are brief sections that present discussions of the potential waterpower, and geothermal resources. Water resource developments and potential water resource developments, water conservation practices, and various research programs on water conservation are discussed. (Knapp-USGS)
W70-03278

MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS,

Geological Survey, Washington, D.C.

H. C. Riggs.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 95-110, Dec 1969. 16 p, 12 fig, 6 tab, 3 ref.

Descriptors: *Streamflow, *Average flow, *Stream gages, *Discharge measurement, *Estimating, Statistical methods, Gaging stations, Rainfall-runoff relationships, Runoff, Hydrographs, Routing, Stage-discharge relations, Data processing.
Identifiers: Streamflow estimating.

Mean flow of a stream is usually computed from a continuous record of flow at a gaging station. A less

costly method consists of (1) estimating 12 individual monthly flows from one discharge measurement per month and a concurrent gaging station record on a nearby stream, using a different relation for each month, (2) computing the annual mean from the estimated monthly means, and (3) using a relation based on gaging station records to estimate the long-term mean from the one annual mean. An annual mean can be estimated within about 10% of its measured value even though both the gaged and ungaged streams are affected by diversions and have different runoff characteristics. The method has greatest utility in regions where mean runoff is not closely related to drainage area. (Knapp-USGS)
W70-03280

A NONLINEAR APPROACH TO RUNOFF STUDIES,

College of Engineering, Madras (India).
For primary bibliographic entry see Field 02A.
W70-03290

AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION,

New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 02A.
W70-03291

FLOOD FORECASTING IN THE RIVER KITAKAMI,

Tohoku Univ., Sendai (Japan). Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02A.
W70-03293

FLOW ROUTING BY DIRECT INTEGRATION METHOD,

Department of Energy, Mines and Resources, Toronto (Ontario). Conservation Authorities Branch.
J. Y. Ding.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 15, p 113-120, 1967. 8 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Flood routing, *Mathematical models, Hydrograph analysis, Unit hydrographs, Overland flow, Water storage, Infiltration, Open channel flow.

Identifiers: *Kinematic wave theory, Watershed models.

A flow routing equation is developed from the continuity equation in the form of the hydrologic equation and a simplified dynamic equation expressed by a general storage-discharge relation. Flow routing thus becomes the solution of kinematic-wave problems. The solution of the routing equation is simplified by using the table of the varied-flow functions, $F(u,n)$, where n is the storage exponent and u is the n -th root of the ratio of outflow to inflow. When inflow is zero, the routing equation can be linearized. For a number of storage elements, the value of the storage exponent, n , is found to vary from 1/2 for orifice to 3 for laminar overland flow. Examples of flow routing are given, with emphasis on Izzard's overland flow hydrographs. It is shown that Izzard's dimensionless hydrograph can be derived from the condition of unsteady laminar varied flow. Several concepts in hydrology are derived mathematically from the routing equation, and a critique of routing methods is presented. (Knapp-USGS)
W70-03294

COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Albert H. Barnes.

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 16, p 121-127, 1967. 7 p, 3 fig, 1 tab, 2 ref.

Descriptors: *Flood routing, *Rainfall-runoff relationships, *Storm drains, *Closed conduit flow, Rational formula, Mathematical models, Digital computers, Simulation analysis, Drainage systems.

Identifiers: Drainage system design.

The numerical solution to the dynamic equations representing unsteady flow have been compared with experimentally observed values taken from a carefully conducted experiment and found to compare favorably within the range of observations. A numerical solution to the hyperbolic partial differential equations expressed unsteady flow, commonly referred to as flood routing, has been accomplished in several different ways. The method utilizing a second-order interpolation commonly referred to as the Lax-Wendroff method, has produced the most nearly stable results. The method of characteristics and the diffusing method of numerical integration have been investigated and have shown to offer no advantage over the Lax-Wendroff method. Experimental observations were conducted in a 3-ft diameter pipe, 822-ft long, with discharges ranging from approximately 5 cfs to approximately 70 cfs, with hydrographs of one to two-min durations. Depth hydrographs were observed at 6 points along the conveyance channel and computed for the same positions. Agreement between computed and observed was within about 5 percent in general. The developed numerical procedure and the digital computer will not provide a basis for improved design of storm drainage systems. (Knapp-USGS)

W70-03295

VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS,

Waterloo Univ (Ontario).

For primary bibliographic entry see Field 07C.

W70-03303

RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING, Gruzin'skii Politekhnicheskii Institut, Tiflis (USSR).

For primary bibliographic entry see Field 02A.

W70-03304

EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA),

Geological Survey, Harrisburg, Pa.

William F. Busch.

Geological Survey Open-file Report, June 1969. 27 p, 9 fig, 3 plate, 3 tab, 12 ref.

Descriptors: *Floods, *Pennsylvania, *Non-structural alternatives, Mapping, Profiles, Hydrographs, Hydrologic data, Data collections, Stage-discharge relations, Streamflow, Flood forecasting, Flood damage, Flood protection, Flood plains.

Identifiers: *Perkiomen Creek, *Oaks (Penn).

Information is presented relative to the extent, depth, and frequency of floods on Perkiomen Creek, Oaks, Pennsylvania from Green Lane Reservoir to the mouth, reach of 20.4 miles. The depth, extent, and frequency of flooding can be estimated for any site along the reach of the Perkiomen Creek under study. Flood data and the evaluation of the data are presented so that local and regional agencies, organizations, and individuals may have a technical basis for making decisions on the use of flood-prone areas. Floodplain inundation studies, when followed by appropriate land-use regulations, are a valuable and economical supplement to physical works for flood control. Both physical works and flood-plain regulations are included in the Comprehensive Plan for

development of the Delaware River basin, of which the Perkiomen Creek is a part. (Knapp-USGS)

W70-03458

BASE-FLOW STUDIES OF LEON AND LAM-PASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968,

Geological Survey, Austin, Tex.

Jack Rawson, and Gerald K. Schultz.

Texas Water Development Board Report 97, June 1969. 9 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Base flow, *Surface-groundwater relationships, *Texas, Streamflow, Groundwater movement, Low flow, Surveys, Rivers.

Identifiers: Lampasas River (Tex), Leon River (Tex).

The purposes of base flow investigation of the Leon and Lampasas Rivers were (1) to determine the quantity of tributary inflow and the amount of interchange of surface and groundwater in the main streams, (2) to relate the nature and concentrations of dissolved constituents in the base flow to geology and to the activities of man, and (3) to evaluate the water for municipal supply, irrigation, and industrial use. Both the Leon and Lampasas Rivers generally gained flow throughout the reaches studied. Flow in the Leon River increased from 4.46 cfs at mile 16.7 to about 58 cfs at mile 0.0, a net gain of 53.5 cfs. During the study, the city of Temple diverted an average of 6.1 cfs from the Leon River. Thus, the gross gain in flow totaled 59.6 cfs. Measured inflow from tributaries was 50.9 cfs, or about 85% of the total gain in mainstream flow. Direct accretions of groundwater in the upper 4.4-mile reach of the mainstream probably accounted for much of the unmeasured gain. The dissolved-solids content of water in the Leon River increased from 253 mg/l at mile 16.7 to more than 400 mg/l. Flow in the Lampasas River increased from 24.6 cfs at mile 15.8 to 112 cfs at mile 0.1, a gain of 87.4 cfs. Measured tributary inflow was 71.5 cfs, or about 82% of the total gain. The concentration of dissolved solids in the Lampasas River decreased from 660 mg/l at mile 15.8 to 385 mg/l at mile 0.1. The base flow in streams throughout the area meets the quality requirements for irrigation and many industrial uses, but water in most streams will require softening for some industrial applications. (Knapp-USGS)

W70-03466

HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, BRAZOS RIVER BASIN, TEXAS, 1955-64,

Geological Survey, Austin, Tex.

Willard B. Mills.

Texas Water Development Board Report 99, Oct 1969. 66 p, 12 fig, 18 tab, 24 ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Texas, Hydrographs, Runoff, Streamflow, Data collections, Hydrologic data, Water storage, Evapotranspiration, Hydrologic budget, Water balance.

Identifiers: Cow Bayou (Tex), Brazos River (Tex).

A study was made of the rainfall, inflow, consumption, and outflow for a group of 9 floodwater-detention structures on a 79.6-square-mile watershed near Bruceville, Texas for the 6 water years 1959-64. During this period annual rainfall varied from 19.18 inches in 1963 to 46.73 inches in 1961 as compared to the 32.25-inch long-term average. Total rainfall for the period 1959-64 ranged from 181.8 inches to 200.8 inches on the drainage areas of the 9 floodwater-detention structures. Runoff from these areas, total for the 6-year period, ranged from 22.2 inches to 42.7 inches. Net reduction in pool content during the period was 220 acre-feet, leaving 748 acre-feet in pool storage. A rain-gage density study for the period 1955-64 indicated that 2 rain gages installed at certain points on the watershed would provide data within 8% of the weighted mean rainfall of the 9 existing rain gages using a 67% confidence limit. An average 1-hour

unit hydrograph with a 5-hour time of rise and 10,400 cfs peak was developed for the watershed. (Knapp-USGS)

W70-03467

THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL,

Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.

Charles E. Rice.

Oklahoma Water Resources Research Institute, Partial Technical Completion Report, 1968. 9 p, 4 fig, 1 ref. OWRR Proj No A-006-OKLA.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Routing, *Model studies, *Hydraulic models, Laminar flow, Turbulent flow, Steady flow, Non-uniform flow, Roughness (Hydraulic).

Identifiers: Grass (Synthetic).

Studies on a synthetic grass material used to simulate a natural vegetation for overland flow conditions show that two regimes of flow occur, one occurring when the flow depth is less than the height of the grass (assumed as laminar flow) and another occurring when the flow depth is greater than the height of the grass (turbulent flow). Because the synthetic grass occupied a considerable portion of the flow depth the physical bottom was assumed as not being representative of the effective bottom. Thus, for turbulent flow an effective bottom was found as the intercept when water surface elevation was plotted versus discharge to the 0.6 power. The Manning coefficient for the turbulent flow range increased slightly with discharge and its value (average of about 0.032) indicated that the synthetic grass had a high retardance to the flow of water. (Knapp-USGS)

W70-03475

RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES,

Antioch Coll., Yellow Springs, Ohio. Dept. of Earth Sciences.

Marie E. Morisawa.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 23, p 173-176. 4 p, 2 tab.

Descriptors: *Streamflow forecasting, *Correlation analysis, *Terrain analysis, Channel morphology, Geomorphology, Runoff forecasting, Statistical methods, Water yield, Discharge (Water).

Identifiers: *Stream length, *Drainage basin morphology.

Correlation of longest stream length and mean annual discharge for 96 watersheds in six different physiographic regions of eastern United States results in correlations indicating that for each region one variable is highly related to the other. The relationship between the two variables is significantly different from region to region; one general equation determined from all data cannot be used for individual regions. However, the statistical validity of the correlations does supply an empirical method which can be used to estimate mean annual discharge in ungaged watersheds within a given region. (Knapp-USGS)

W70-03487

PALEOHYDROLOGY: APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST,

Colorado State Univ., Fort Collins. Dept. of Geology; and Geological Survey, Fort Collins, Colo.

For primary bibliographic entry see Field 02A.

W70-03490

THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW,

Melbourne Univ., Parkville (Australia). Dept. of Agricultural Engineering.

For primary bibliographic entry see Field 02A.

W70-03492

STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.

Rafael G. Quimpo.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 38, p 290-297, 1967. 8 p, 2 fig, 3 tab, 13 ref. NSF Grant GK-169.

Descriptors: *Streamflow forecasting, *Statistical methods, *Correlation analysis, *Stochastic processes, *Markov processes, *Mathematical models, Probability, Time series analysis, Frequency analysis, Synthetic hydrology, Fourier analysis. Identifiers: Spectral analysis.

A mathematical representation for series of daily streamflows is postulated. The model is made up of a periodic and a stochastic component. The periodic component is applied both to 365 mean daily flows and to 365 standard deviations about these means. Five rivers are used to show the method of approach. First, periodic components were detected, in the daily means, and in standard deviations and isolated by using spectral analysis. Then, autoregressive schemes were fitted to stationary stochastic series after the periodic components had been removed. Finally, stochastic components of these series for all five rivers were found to be well fitted by the second order Markov linear model. (Knapp-USGS)

W70-03497

ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS,

Waterloopkundig Laboratorium, Delft (Netherlands).

For primary bibliographic entry see Field 08B.

W70-03545

2F. Groundwater**HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO,**

Geological Survey, Boise, Idaho.

N. P. Dion.

Idaho Department of Reclamation Water Information Bulletin No 13, Oct 1969. 66 p, 14 fig, 7 tab, 22 ref.

Descriptors: *Water resources, *Groundwater, *Idaho, Irrigation water, Water sources, Aquifers, Hydrogeology, Water wells, Water quality, Recharge, Water yield, Water table, Canal seepage, Seepage. Identifiers: Bear River basin (Idaho).

The areal distribution of precipitation in the Bear River basin, Idaho is controlled chiefly by elevation, and quantities range from less than 10 inches in Bear Lake Valley to more than 45 inches on the Bear River Range. Precipitation on the basin averages about 2.3 million acre-ft per year. Groundwater occurs in the alluvium of all the valleys, the basalt of Soda Creek basin and Gem Valley, the Salt Lake Formation, the fractured bedrock, and possibly in the Wasatch Formation. The basalt and the alluvium are the most productive aquifers in the basin and are best able to withstand additional groundwater development. The basalt yields as much as 3,500 gpm and the alluvium as much as 2,500 gpm to wells. While many wells drilled into the Salt Lake Formation are non-productive, those that are successful yield as much as 1,800 gpm. The principal sources of recharge to the aquifers include precipitation, spring snowmelt and runoff, seepage of irrigation water, and some leakage of water from Blackfoot Reservoir through the Blackfoot Lava Field into the Bear River basin. (Knapp-USGS)

W70-03254

HYDROGEOLOGY OF A VOLCANIC ISLAND

CHE JU DO, KOREA, Geological Survey of Israel, Jerusalem. Hydrogeological Div. Yoram Eckstein.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 45-60, Dec 1969. 16 p, 9 fig, 4 tab, 12 ref.

Descriptors: *Groundwater, *Water resources, Recharge, Water levels, Basalts, Volcanoes, Permeability, Aquifers, Surveys, Water wells, Climates, Precipitation (Atmospheric). Identifiers: Che Ju Do (Korea).

Che Ju Do is a volcanic island offshore from the Korean Peninsula. The island is an extinct volcano, petrologically a part of the intra-pacific province of the olivine-basalt-trachyte association. The last volcanic activity has been reported in old manuscripts. Climate of the island is primarily influenced by the Pacific monsoon pattern and the northwest winter Siberian winds. A highly permeable basaltic surface of the mountainous central part of the island, coincident with the highest precipitation in the area, results in good recharge of groundwater. Groundwater appears as perched horizons on impermeable planes between lava flows, but most of the reserves are stored in a basal fresh water lens, which floats upon and displaces the sea water beneath the island. (Knapp-USGS)

W70-03258

BRANCHING-TYPE MODELS OF FLOW THROUGH POROUS MEDIA,

Illinois Univ., Urbana. K. H. Liao, and A. E. Scheidegger.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 137-145, Dec 1969. 9 p, 3 fig, 1 tab, 6 ref.

Descriptors: *Groundwater movement, *Dispersion, Flow, Porous media, Diffusion, Probability, Stochastic processes, Statistical methods, Statistical models, Model studies, Computer models, Fluid mechanics, Hydraulics. Identifiers: Graph models, Random-graph theory.

A random-graph model is used to explain the mechanics of flow through porous media. The approach is extended to the discussion of a three-dimensional random-graph model and to an investigation of lateral dispersion in porous media. Comparisons with experimental results are given. (Knapp-USGS)

W70-03262

KARSTIC WATER RESEARCH IN HUNGARY,

Research Inst. for Water Resources Development, Budapest (Hungary). Karstic Water Research Section.

T. Bocker.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 7-20, Dec 1969. 14 p, 10 fig, 1 tab.

Descriptors: *Karst, *Groundwater movement, Water resources, Mine drainage, Water management (Applied), Reviews, Surveys, Aquifers, Water wells, Springs, Water yield, Withdrawal, Model studies, Analog models. Identifiers: *Hungary.

Hungarian research on karst phenomena is reviewed. In Hungary, about 40% of coal production, all bauxite production, and all manganese production are from mines below the karstic water level. Mine drainage and the danger of flooding by karstic water are important subjects of research. Volumes pumped and spring flow are tabulated. Drawdown caused by pumping is mapped and briefly discussed. Model tests are used to predict effects of withdrawal. (Knapp-USGS)

W70-03264

GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA,

Geological Survey, Phoenix, Ariz.

For primary bibliographic entry see Field 04B. W70-03267

A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS,

C. Venetis.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 119-125, Dec 1969. 7 p, 1 fig, 3 ref.

Descriptors: *Aquifers, *Drawdown, *Mathematical models, Recharge, Discharge (Water), Water level fluctuations, Groundwater movement, Water table, Withdrawal.

Identifiers: Unconfined aquifers.

The dependence of recession of the groundwater levels and groundwater discharge upon the initial state of the aquifer is examined for deep unconfined aquifers. It is shown that only in the early stages of the recession does the initial state exert a limited influence on the recession. An estimate is made of the upper limit of the time for which the recession becomes effectively independent of the initial state of the aquifer, valid for physically realistic initial states. For useful aquifers initial time cannot be expected to exceed one month. Empirical recessions often are found to be consistent and of an exponential form. (Knapp-USGS)

W70-03274

MINERAL AND WATER RESOURCES OF ARIZONA: PART 2. WATER RESOURCES; AND PART 3. WATER RESOURCE DEVELOPMENT,

Geological Survey, Tucson, Ariz.; and Bureau of Reclamation, Phoenix, Ariz.

For primary bibliographic entry see Field 02E.

W70-03278

SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA,

Shell Oil Co., Denver, Colo. Rocky Mountain Div.; and Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering.

D. B. McWhorter, and A. T. Corey.

French summary included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins, Vol 1, Paper 18, 136-140, 1967. 5 p, 2 fig, 11 ref.

Descriptors: *Simulation analysis, *Model studies, *Synthetic hydrology, *Porous media, *Unsaturated flow, Immiscibility, Flow, Porosity, Permeability, Aquifers, Hydraulic models.

Identifiers: Similitude analysis, Multiphase flow.

Criteria of similitude are derived for systems in which two immiscible fluids move simultaneously through a porous medium as, for example, when air replaces water or water replaces air in aquifers. The similitude requirements are established by writing the combined equation of flow, and scaling this with system parameters. The system parameters are selected so that the equation of flow in terms of scaled variables provides a maximum generality and indicates criteria which are the least restrictive and which can be satisfied with laboratory models. The unique feature of this statement of the criteria of similitude (compared to those previously published) is that similitude of the media is determined by the equivalence of a single dimensionless parameter associated with pore-size distribution. The validity of the theory is demonstrated by experiments in which the behavior of similar models are compared. (Knapp-USGS)

W70-03297

GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA,

Geological Survey, Washington, D.C.

G. C. Tibbitts, Jr.

Field 02—WATER CYCLE

Group 2F—Groundwater

Geol Surv Open-file Report, July 1966. 184 p, 30 fig, 12 tab, 28 ref.

Descriptors: *Water resources, *Groundwater, *Arid lands, Artesian wells, Irrigation water, Water supply, Water wells, Water yield, Water quality, Climates, Precipitation (Atmospheric), Hydrogeology.
Identifiers: *Libya, Ash Shati, Oases, Sahara.

Flowing wells, springs, and dug wells that yield water of fair to good chemical quality supply a string of oases in Ash Shati' Libya area. The depression locally receives very infrequent runoff from ephemeral streams rising in the north, but never from the adjacent sand sea to the south. Precipitation averages about 5 mm annually, but in many years no rain falls. Sandstone of Devonian age is the important aquifer of the area, containing water of fair to good chemical quality which is confined under sufficient pressure to flow naturally at many places along Wadi ash Shati'. Contemporary recharge of groundwater in Ash Shati' area is scant and infrequent. Probably much of the water in the aquifer system dates from the Pleistocene. Discharge of water through wells and springs has increased, because of recent drilling, to about 83,000 cu m/day. Pressure head declined about 3 m from 1950 to 1962. About 43% of the discharge is wasted. The excess water causes waterlogging. Evaporation of the water deposits salts in soil in such quantity as to alter soil structure and stunt or preclude growth of crops. (Knapp-USGS)
W70-03306

MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS, Geological Survey, Denver, Colo.

For primary bibliographic entry see Field 08H.

W70-03375

WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, Geological Survey, Tallahassee, Fla.

Henry G. Healy.

Florida State Department of Natural Resources, Bureau of Geology, Information Circular No 61, 1970. 71 p, 47 fig, 1 tab, 1 append.

Descriptors: *Water levels, *Water wells, *Aquifers, *Water level fluctuations, *Florida, Data collections, Hydrologic data, Hydrographs, Surveys, Investigations, Artesian wells.
Identifiers: Florida aquifers.

Water level data from the principal aquifers of Florida, 1965-66 are summarized in tables, hydrographs, and maps. Although groundwater supplies have been adequate in most areas, water levels have declined appreciably in some. Because demand for groundwater continues to increase, shortages will occur and may become critical in some areas. In coastal areas, declining water levels may allow salt water to encroach and shortages could result from deterioration in quality as well as from the reduction of quantity of water available. The water-level data represent measurements taken from automatic water-stage recorder charts, pressure gages, and made by tape. Highest and lowest water levels of record prior to 1965 are given. (Knapp-USGS)
W70-03443

RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH, Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences. Harry D. Goode.

Report available for sale from Utah Geological and Mineralogical Survey, Univ of Utah, Salt Lake City - Price \$2.00. Water Resources Bulletin 11, Utah Geological and Mineralogical Survey, Oct 1969. 38 p, 5 fig, 12 plate, 8 tab, 22 ref.

Descriptors: *Water resources, *Groundwater, *Utah, Water wells, Aquifers, Sandstones, Water yield, Water quality, Arid lands, Irrigation water, Water resources development.
Identifiers: Escalante (Utah), Garfield County (Utah).

Surface waters, except for outflow of perhaps 4,000 to 5,000 acre-ft a year down Escalante Canyon and Alvey Wash, Utah are essentially fully appropriated. Dams in Escalante Canyon or Pine Creek or drains in the valley fill in Escalante Canyon and Alvey Wash could capture most of the outflow. Because the water so captured would not satisfy the amounts desired for irrigation, the Entrada (base about 600 ft deep) and/or Navajo Sandstones (top about 1000 ft deep) are suggested for groundwater development. Both formations are porous enough to be good aquifers and both are in favorable geologic positions for producing water. If the Navajo is saturated throughout its thickness of 1500 ft, tremendous quantities of water, estimated at 50,000 to 60,000 acre-ft per sq mi, are in storage and are probably under artesian pressure from the recharge area of the Navajo along the axis of the Escalante anticline. Development of either or both of these probable aquifers could yield the desired 15,000 acre-ft of water from perhaps twenty 20-inch wells. Chemical analyses of spring and surface waters suggest that good water is available from both springs and surface waters. (Knapp-USGS)
W70-03454

RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS,

Geological Survey, Austin, Tex.

R. K. Gabrysch, W. L. Naftel, and Gene McAdoo. Texas Water Development Board Report 103, Dec 1969. 252 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Water levels, *Groundwater, *Observation wells, *Data collections, *Texas, Hydrologic data, Water level fluctuations, Aquifers.
Identifiers: *Harris County (Tex.).

A compilation of water-level measurements for Harris County, Texas wells for 1929-1969 is presented. Water-level measurements in most observation wells are made annually, but some measurements are made monthly, quarterly, or semiannually. A continuous record is obtained at a few locations where water-stage recorders are installed. If numerous measurements in a well were made during a short period of time or if water-level data were obtained from a water-stage recorder, representative water levels were selected for publication. (Knapp-USGS)
W70-03477

OCCURRENCE AND QUALITY OF GROUND-WATER IN SHACKELFORD COUNTY, TEXAS, Texas Water Development Board, Austin.

Richard D. Preston. Texas Water Development Board Report 100, Oct 1969. 58 p, 14 fig, 8 tab, 61 ref.

Descriptors: *Water resources, *Groundwater, *Water quality, *Texas, Water pollution sources, Brines, Oil fields, Aquifers, Water wells, Water yield, Data collections, Hydrologic data.
Identifiers: Shackelford County (Tex.).

Shackelford County is in the drainage basin of the Brazos River in north-central Texas. Permian rocks of the Wichita and Clear Fork Groups, dipping gently to the northwest, are found at the surface within the county. Alluvial deposits of Quaternary age are found along the major streams in the county. Small amounts of groundwater, used mostly for household needs and watering livestock, are produced from formations of Permian age and from Quaternary alluvial deposits. Methods of disposal of oil-field brines are the probable cause of some of the poorer water quality in Shackelford County. Disposal of brine is also responsible for extensive soil damage and vegetative kill in some areas of the county. (Knapp-USGS)
W70-03460

tensive soil damage and vegetative kill in some areas of the county. (Knapp-USGS)
W70-03460

GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL MINNESOTA, Geological Survey, Washington, D.C.

L. H. Ropes.

Available from US Geological Survey, Wash, DC, 20240 -- Price \$0.50. Geological Survey Hydrologic Investigations Atlas HA-334, 1 sheet, 1969. Text, 14 fig, 1 tab, 4 ref.

Descriptors: *Water resources, *Groundwater, *Minnesota, Aquifers, Water yield, Water quality, Water wells, Water supply, Hydrogeology, Hydrologic data, Water table, Water sources.
Identifiers: St. James (Minn.).

A 1-sheet hydrological atlas shows the quality and quantity of groundwater resources in the area of St. James, Minnesota on maps, charts, cross sections and text. The area is covered by a thick layer of glacial drift which is underlain by Cretaceous, Cambrian, and Precambrian rocks. St. James presently obtains its water supply from two aquifers. One is a Cretaceous sandstone 160 ft below the surface, in which two wells are completed. This aquifer yields abundant water but it is of poor quality and is expensive to treat. The second source, tapped by three municipal wells, is a surficial sand and gravel deposit less than 40 ft thick at the well field. This aquifer produces water of better quality, but its extent and capacity are not known. There are other wells in the area completed at depths ranging from 15 to 500 ft. The surficial sand and gravel aquifer is easily drilled and contains water of good quality. Pumping tests on wells 3780 and 5756 indicate coefficients of transmissibility (T) of 3,000 and 10,000 gpd/ft respectively. The storage coefficient (S) is estimated to be in the range of 0.1 to 0.2. An abundant supply of moderately to highly mineralized water is available from the Cretaceous sandstone aquifer at depths generally less than 200 feet. (Knapp-USGS)
W70-03477

ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS, Kyoto Univ. (Japan). Disasters Prevention Research Inst.

For primary bibliographic entry see Field 02A.
W70-03489

2G. Water in Soils

MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, Stanford Univ., Calif.

Stanley N. Davis, Frank L. Peterson, and Allan D. Halderman.

Report available from Clearinghouse as PB-182 483, \$3.00 in paper copy, \$0.65 in microfiche. Final Report of Stanford University to National Science Foundation on Project: Micromovements of the Land Surface Produced by Subsurface Flow of Fluids, 1969. 32 p, 4 fig, 14 ref. NSF Project GP-985.

Descriptors: *Groundwater movement, *Strain, *Strain measurement, *Extensometers, Subsidence, Withdrawal, Instrumentation, Darcys law, Discharge (Water), Water level fluctuations, Aquifers, Elasticity (Mechanical).
Identifiers: Earth strain-groundwater relations, Aquifer strain.

Fluid flow to wells produces strain that has been measured as horizontal, vertical, and rotational displacements of reference points fixed on the ground surface. Most linear displacements measured were between 1 and 100 microns and angular displacements were a few microradians. Of the various devices used, a horizontal extensometer proved to

be the most accurate and versatile. Deflections of the land surface resembled quite closely the theoretical vertical deflections caused by a point load on a plate of infinite extent resting on an elastic foundation. Short-term reactions of aquifers are largely elastic except in geologically young materials. Significant horizontal strain was measured in all materials tested. This suggests that accepted equations for fluid discharge from wells should be modified for special conditions near the wells.

W70-03455

HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING,

Agricultural Research Service, Beltsville, Md. Hydrograph Lab.

H. N. Holton, C. B. England, and W. H. Allen, Jr. French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 29, p 218-226, 1967. 9 p, 5 fig, 3 tab, 10 ref.

Descriptors: *Infiltration, *Surface-groundwater relationships, *Model studies, *Mathematical models, Vegetation effects, Soil water movement, Percolation, Overland flow, Runoff, Hydrologic budget, Water storage, Evapotranspiration.

Identifiers: Intermittent rainfall-infiltration model.

A mathematical model is proposed for computing infiltration during intermittent rainfall based upon readily available information on soils and vegetation. The model is adapted to long-term soil moisture accounting and to the computations of areal and temporal distributions of rainfall excess during a storm in sequences compatible with the hydraulics of overland flow. (Knapp-USGS)

W70-03493

THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,

Cornell Univ. Ithaca, N.Y.

Hassan A. Ibrahim, and Wilfried Brutsaert.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 30, p 227-234, 1967. 8 p, 6 fig, 11 ref.

Descriptors: *Unsaturated flow, *Porous media, *Drainage, *Mathematical models, Groundwater movement, Soil water movement, Infiltration, Hydrograph analysis, Runoff forecasting, Equations.

Identifiers: Flow equations.

Some numerical solutions of the differential equation describing flow in partly saturated porous media are presented. A high speed digital computer was used to obtain these solutions for different initial and boundary conditions representing alternating infiltration and drainage cycles. The hysteresis in the moisture-suction relationship was taken into account and its effect was studied. To increase the applicability of the solutions to a wider variety of field conditions, they are given in dimensionless form. The implications of the obtained results in connection with hydrograph analysis are discussed. (Knapp-USGS)

W70-03495

2H. Lakes

GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA,

Ontario Water Resources Commission, Toronto.

For primary bibliographic entry see Field 05B.

W70-03253

A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,

Geological Survey, Tallahassee, Fla.

For primary bibliographic entry see Field 05C.

W70-03260

GREAT SALT LAKE, UTAH: CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966,

Geological Survey, Salt Lake City, Utah.

D. C. Hahl, and A. H. Handy.

Report available for sale from Utah Geological and Mineralogical Survey, Salt Lake City, Utah for \$2.00. Utah Geological and Mineralogical Survey Water Resources Bulletin 12, 1969. 33 p, 16 fig, 7 tab, 26 ref, append.

Descriptors: *Water chemistry, *Brines, *Great Salt Lake, *Utah, Saline Lakes, Water quality.

Identifiers: Brine properties.

Studies to define the variations in chemical and physical characteristics of Great Salt Lake brine began in 1963. Four types of brine coexist in the lake. Completion of a railroad causeway by the Southern Pacific Co. in 1957 divided the lake into 2 parts and altered the movement of brine. The northwestern part of the lake was essentially cut off from direct fresh-water inflow by the causeway, and as a result it was saturated and well mixed from 1963 to 1966. The southern two-thirds of the lake receives over 90% of the surface inflow and since 1957 has rarely reached saturation. The southern part of the lake is not well mixed, and 3 types of brine have been identified. These brines are located (1) in a zone from the surface to a depth of about 16 ft, (2) in the zone below 16 ft south of the causeway, and (3) in the zone below 16 ft in the south end of the lake. Brine in the shallow southern zone is usually the most dilute of any brine in the lake. The concentrations of dissolved solids of the deep brines vary seasonally. Brine in the deep zone near the south side of the causeway is maintained by a density current that flows from the northern part of the lake through the causeway. Brine in the deep zone at the south end of the lake has a high concentration of sodium and low concentration of sulfate. Brine north of the causeway is reddish-brown and visibility in it is about 2 ft, whereas brine south of the causeway is green and features 15 ft deep can often be clearly seen. (Knapp-USGS)

W70-03279

FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD-WATER LAKES,

Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.

Robert G. Wetzel.

Verhandlungen der Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 72-85, Nov 1969. 8 fig, 10 tab, 22 ref.

Descriptors: *Photosynthesis, *Organic matter, *Lakes, *Aquatic plants, *Hardness (Water), Marl, Productivity, Great Lakes, Inorganic compounds, Tracers, Biomass, Calcium, Temperature, Light intensity, Magnesium, Sodium, Potassium, Ecology, Diatoms, Phosphates, Hydrogen ion concentration, Carbon radioisotopes, Metabolism, Oxygen, Hypolimnion, Algae, Bacteria.

Identifiers: *Macrophytes, *Excretion, Dissolved organic compounds, *Najas flexilis*.

Experimental results with *Najas* and concomitant investigations on phytoplanktonic organic-inorganic nutrient relationships and direct organic-inorganic chemical interactions show some major cyclic factors regulating photosynthesis in calcareous lakes. Marl lakes exhibit low primary production rates and relatively high hypolimnetic oxygen concentrations which usually remain, although reduced, through or to terminal summer stratification, compounded by years of partial, usually vertical, meromixis. Sedimentary nutrient release is variable and upon recirculation into the alkaline trophogenic zone, largely lost as relatively insoluble carbonates hydroxides, and phosphates, some loss is permanent in dense, calcareous sediments. High levels of calcium, bicarbonate-ion and carbonate-ion combined with high magnesium, low levels of sodium and potassium, and high pH, form a buffered trophogenic littoral zone, relatively untenable for assimilation of certain nutrients. Calci-

um carbonate in colloidal and particulate form adsorbs certain dissolved organic compounds and this complex serves as a 'sump' reducing function of dissolved organics in direct metabolic utilization and complexing of physiologically unavailable metallic nutrients. Availability of carbon and differential bicarbonate utilization appear major limitations to photosynthetic production. These factors, among others, and their interactions function in a dynamic cyclic causal system to self-perpetuate suppressed potential productivity in marl lakes. (Jones-Wisconsin)

W70-03307

A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR,

Minnesota Univ., Minneapolis. School of Public Health.

T. A. Olson.

Technical Completion Report, June 1969. 2 p.

OWRR Project No A-011-MINN.

Descriptors: *Lakes, *Great Lakes, *Lake Superior, *Eutrophication, *Zooplankton, *Primary productivity, Lake Huron, Lake Michigan, Lake Erie, Water pollution effects, Bioindicators, Carbon radioisotopes, Phytoplankton, Water pollution sources, Environmental effects, Secondary productivity, Water quality, Oligotrophy, Analytical techniques.

Identifiers: *Net plankton, Hardy Continuous Plankton Recorder, Radiocarbon uptake technique, Plankton abundance, Plankton distribution, Seasonal variations, Daily variations, Water masses, Water pollution assessment.

Based upon criteria of net plankton abundance, determined with the Hardy Continuous Plankton Recorder (CPR), and primary plankton productivity (PPP), determined from measurements of carbon-14 uptake, the status of four Great Lakes sampled, in increasing order of eutrophication, is: Superior, Huron, Michigan, Erie. Lake Erie is more than fourfold productive than any other lake sampled. Eutrophication increases progressively from north to south. Mean seasonal productivity generally increased with ascending temperature of surface waters. Sharply delineated regions of high zooplanktonic density was observed, as expected. Species composition and abundance of zooplankton differ among water masses within lakes, showing seasonal and daily variations. Zooplankters are more abundant locally in chemically polluted areas within lakes. Lowest PPP was observed in central Lake Superior. Lower lakes are most productive, and especially marked increases in PPP occur in regions where massed population and industry have enriched the lakes. Radiocarbon uptake and CPR are effective tools for study of trophic status of waters of Great Lakes Basin, and CPR can provide assessment of pollution and eutrophication on a scale hitherto unavailable for the Great Lakes. (Eichhorn-Wisconsin)

W70-03311

COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES,

Toronto Univ (Ontario). Dept. of Zoology; and Fisheries Research Board of Canada, Winnipeg (Manitoba).

R. O. Brinkhurst, A. L. Hamilton, and H. B. Herrington.

Great Lakes Institute, Univ of Toronto, No PR 33, Mar 1968. 50 p, 7 tab, 23 ref, appendix with 11 fig.

Descriptors: *Benthic fauna, *Great Lakes, *St Lawrence River, Oligochaetes, Sampling, Seasonal, Depth, Lake Erie, Lake Ontario, Tubificids, Distribution, Water pollution, Eutrophication, Oligotrophy, Littoral, Limnology, Bathymetry, Temperature, Ecology, Trophic, Lake Huron, Oxygen.

Identifiers: Sphaeriidae, Chironomidae, Georgian Bay (Ontario), Mesotrophic, Lake Nipigon (Ontario), Lake Athabasca (Ontario), Great Slave

Field 02—WATER CYCLE

Group 2H—Lakes

Lake (Ontario), Cree Lake (Ontario), Patricia District Lakes, Straits of Mackinac, Species composition, Detroit River, Maumee River, Taxonomy, Core analyses, Chemical conditions, Taxonomic keys.

Bottom fauna were sampled during synoptic cruises through Georgian Bay, Lake Ontario, and Lake Erie and distributions of their major components determined. Oligochaeta, Sphaeriidae, and Chironomidae were separated. Identity of species and their distribution is discussed. Reference is made to other Great Lakes studies on benthos. Samples representing all seasons were included where possible. Results are presented in taxonomic groups and distribution maps. Maps of depth profiles, indicating degree of oxygen depletion in Lake Erie in summer, and bathymetrical maps are included. 31 species of Tubificidae from the Great Lakes and some in Canadian lakes are recorded. In grossly polluted situations, the number of Oligochaetes is very high. Species of the Sphaeriidae identified in the Great Lakes Institute collection are listed. The taxa of Chironomidae, reasonably complete in assessment of the profundal and sublittoral fauna, from these three lakes are listed. To facilitate comparison between these lakes a measure of the 'trophic conditions' of each area was calculated according to ability to withstand eutrophic conditions, providing numerical values which aid in the comparisons of various bodies of water. Key to Tubificidae is given. (Jones-Wisconsin)
W70-03315

CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN,
Tokyo Univ. (Japan). Geographical Inst.
Shinkichi Yoshimura.
Japanese Journal of Geology and Geography, Vol 10, No 1-2, p 33-60, 1932. 2 fig, 7 tab, 52 ref.

Descriptors: *Lakes, *Japan, *Calcium, *Carbonates, Carbon dioxide, pH, Stratification.
Identifiers: *Calcium stratification, Holopodium gebberum, Soft-water lakes, Hard-water lakes, Japanese lakes.

The determination of calcium, carbonates, carbon dioxide, and pH of several Japanese lakes disclosed their very low calcium content. The maximum observed concentration of calcium was 25 parts per million; in most lakes the content is between 5 and 10 parts/million. No deposits of marl or calcium carbonate incrustations have yet been observed in Japanese inland lakes. In comparison with inhabitants of hard waters, the shells of mollusca are very thin. Slight stratification of calcium during the stagnation period is not due to precipitation as calcium carbonate, but some other, thus far undisclosed, causes. The one inhabitant well tolerating the low calcium content is Holopodium gebberum. (Wilde-Wisconsin)
W70-03316

EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE,
Tennessee Valley Authority, Norris. Fish and Wildlife Branch.
C. E. Wood, and T. L. Shedd.
Tennessee Valley Authority, Fish and Wildlife Branch publication, 1968. 19 p, 5 fig, 11 tab, 8 ref.

Descriptors: *Fertilizers, *Fish food organisms, Aquatic insects, Nitrogen, Phosphorus, Benthic fauna, Forage fish, Tennessee, Zooplankton, Food chains.
Identifiers: *Fish production, Game fish, Norris Reservoir (Tennessee), Clinch River (Tennessee).

Six coves of Norris Reservoir were treated with fertilizer (monoammonium phosphate and ammonium sulfate) in order to (1) ascertain effects of fertilizer on production of game fish and fish food organisms and (2) determine the practibility of fertilization for improvement of game fish production

in specific areas. Coves were fertilized at rates of 100 and 50 micrograms/liter nitrogen and 50 and 25 micrograms/liter phosphorus; 2 coves served as controls. Three zooplankton blooms were noted following fertilization, one coinciding with increasing temperature and one coinciding with increased rainfall and surface runoff. Rotifers were most numerous in all coves, copepods and cladocerans were of secondary importance among the zooplankton. Tendiped larvae dominated benthic fauna; tubificids and midge larvae (Ceratopogonidae) contributed important numbers. Benthic fauna were significantly more abundant in coves exposed to lower fertilizer levels. Forage fish dominated samples; no numerical increase of game fish was noted. Amount of fertilizer lost through sinking and flushing was not determined. Graphical and tabular data include hydrography, chemical analyses, and biological analyses of samples from all coves. (Voigtlander-Wisconsin)
W70-03317

THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (In German), Gustav Wagner.

English summary. Archiv fur Hydrobiologie, Vol 61, No 3, p 395-401, June 1965. 1 fig, 3 tab, 10 ref.

Descriptors: *Nitrogen, *Nitrates, *Nitrate, *Phosphorus, Stratification, Thermal stratification, Ammonia, Depth, Water quality, Nitrogen.
Identifiers: Lake Constance, Obersee (Bodensee).

Analyses of water in the early April 1964 indicated incomplete thermal circulation during the preceding winter. The effect of water of different quality produced irregularities in stratification. The content of ingredients (phosphate, ammonium, nitrite, and nitrate) in the beginning of spring stagnation showed that during the past five years the annual increase of nitrate nitrogen was at a rate of 100 to 150 milligrams/cubic meter, and that of phosphorus at a rate of 2 milligrams/cubic meter. (Wilde-Wisconsin)
W70-03318

STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM, Kyoto Univ. (Japan). Otsu Hydrobiological Station.

Yoshimasa Toyoda, Shoji Horie, and Yatsuka Saito.

German summary. Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, p 243-255, Mar 1968. 8 fig, 2 tab, 10 ref.

Descriptors: *Lakes, *Metabolism, *Sedimentation, *Seasonal, Stratification, Nitrogen, Phosphorus, Seston, Bottom sediments, Inflow, Degradation (Decomposition).
Identifiers: *Lake Biwa, Euphotic layer, Lake metabolism, Seasonal effects, Chlorophyll a, Sediment age.

The annual rate of deposition of suspended matter near the bottom of Biwa, the largest lake in Japan (674 square kilometers), was estimated as 208 grams/square meter on dry weight basis. The maximum daily deposition of 3 to 6 grams/square meter was in April and May; it decreased in winter to 0.1 gram/square meter. The process was in fair agreement with water outflow, but no correlation was discovered between deposition and the amount of seston. A considerable fraction of organic nitrogen reaches the deposit, whereas most of phosphorus is converted into silicate form in the trophogenic layer. Annual contribution of organic nitrogen to the deposit was only 1/8 to 1/20 of its supply provided by primary production and inflow of seston. Age of bottom sediment was determined on the basis of annual deposition and total content of silicates. The yearly decomposition of nitrogen compounds in the bottom sediment was estimated as

680 milligrams/square meter; that of phosphorus compounds, as 130 milligrams/square meter. (Wilde-Wisconsin)
W70-03319

LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET, Uppsala Univ. (Sweden). Inst. of Limnology.

Ingemar Ahlgren.
Schweizerische Zeitschrift fur Hydrologie, Vol 27, No 1, p 53-90, 1967. 22 fig, 7 tab, 46 ref.

Descriptors: *Eutrophication, Inflow, Sampling, Water analysis, Temperature, Oxygen, Hydrogen sulfide, Iron, Sedimentation, Water pollution effects, Water pollution, Water pollution sources, Nitrogen, Phosphorus, Nutrients.

Identifiers: *Lake Norrviken (Sweden), Ruttner water sampler, Oxygen concentration, Madison (Wis) lakes, Transparency, Nutrient budget.

Discharge of yeast factory refuse and sewage from communities involving 1,300 people have imparted to 266 hectare Lake Norrviken in central Sweden, an extreme degree of eutrophication. Nitrogen and phosphorus are now accumulating in amounts of 44,000 and 5,280 kilograms/year, respectively. The present nitrogen concentration is as high as 3.4 parts per million (ppm) and that of phosphorus 0.26 ppm, inducing luxuriant development of macrovegetation and planktonic algae. The two major consequences include nuisance bloom of blue-green algae and a critical deficiency of oxygen; under ice cover the entire mass of water becomes oxygen-free. Water waste from the yeast factory delivers more than 80% of nitrogen and 70% of phosphorus. Phosphorus accumulates in the sediment; a large fraction of nitrogen compounds presumably undergoes reduction to free nitrogen. (Wilde-Wisconsin)
W70-03322

FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO,

Toronto Univ. (Ontario); and Department of Lands and Forests (Ontario).

R. R. Langford.
Transactions of the American Fisheries Society, Vol 78, p 133-144, 1948. 5 fig, 4 tab, 7 ref.

Descriptors: *Fertilization, *Lakes, Productivity, Phytoplankton, Nutrients, Zooplankton, Diatoms, Protozoa, Rotifers, Copepods, Oceans, Fresh water, Biota, Environment, Benthos, Forage fish, Biomass, Nitrogen, Phosphorus, Potassium, Acrage, Depth, Epilimnia, Nannoplankton.

Identifiers: *Algonquin Park (Ontario), Flagellates, Chemical fertilizer, Game fish, Brewer Lake (Ont), Cache Lake (Ont), Dissolved chemicals, Fragilaria Tabellaria, Melosira, Dinobryon, Asterionella, Synura, Cyclops, Keratella, Notholica, Polyarthra, Diaptomus, Kearney Lake (Ont), Costello Lake (Ont), McCauley Lake (Ont).

Since many lakes in the Canadian Shield area of Ontario are poor in dissolved minerals and low in fish productivity, an investigation was made of the possibilities of increasing yield by fertilization. For a complete analysis of fertilization results, changes in the complex biota and physical environment were followed. Fertilization was begun in Algonquin Park in 1946 as part of the investigation of factors controlling lake productivity. Four lakes had been fertilized and one other used as a control. Detailed analyses were conducted to assess changes in dissolved chemicals, the plankton, bottom organisms, forage fish, and game fish, in order to determine the fate of the augmented inorganic nutrients in the biomass. The response of phytoplankton and zooplankton populations to increased nutrients is indicated. Marked increase in net phytoplankton occurred in each lake from three weeks to a month after first application. Diatoms and flagellate protozoans showed the greatest increment. Rise in zooplankton organisms

was relatively lesser than of phytoplankton although the rotifer populations did increase in all lakes. (Jones-Wisconsin)
W70-03323

THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN US RESERVOIRS, Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.

Robert M. Jenkins.

Reservoir Fishery Resources Symposium, Athens, Georgia, Apr 5-7, 1967, p 298-321, Nov 1968. 4 fig, 9 tab, 18 ref.

Descriptors: *Environmental effects, *Reservoir fisheries, Commercial fish, Dissolved solids, Multiple-purpose reservoirs, Regression analysis, Sport fish, Fish, Standing crop, Reservoirs.

Identifiers: Clupeids, Multiple regression analysis, Storage ratios.

Multiple regression analyses were performed to ascertain the effects of nine environmental factors on sport and commercial fish standing crops and harvests in 127 reservoirs in 33 states. Factors exerting greatest positive influence included total dissolved solids on standing crop and sport fish yield; age of reservoir on clupeid standing crop and commercial harvest. Strong negative influences include age of reservoir on sport harvest; area on sport harvest; mean depth and shoreline development on commercial harvest. Multiple regression models of greatest predictive utility include standing crop on dissolved solids divided by mean depth; standing crop on dissolved solids, shore development and storage ratio; commercial harvest on growing season, mean depth, storage ratio, age, and water level fluctuation. Tabular data include results of single-factor and multiple regressions and a complete tabulation of all data utilized on the reservoirs studied. (Voigtlander-Wisconsin)

W70-03324

SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION,

British Columbia Univ., Vancouver. Inst. of Fisheries.

Mike Dickman.

Limnology and Oceanography, Vol 14, No 5, p 660-666, Sept 1969. 6 fig, 11 ref.

Descriptors: *Lakes, *Phytoplankton, *Primary productivity, Light intensity, Biomass, Water pollution effects, Eutrophication, Oligotrophy, Nannoplankton, Limiting factors, Rainfall, Carbon radioisotopes, Environmental factors, Chlorophyta, Temperature, Diatoms, Periphyton, Grazing, Correlation analysis, Nutrients.

Identifiers: *Lake renewal, *Species composition, Marion Lake (B C), British Columbia, Canada, Flushing rates, Ratio (Production/Biomass), Instantaneous productivity rates, Radiocarbon uptake technique, Denmark, North Alouette River (B C), Pyrheliometry, Algal growth, Oocysts, Elakatoothrix, Desmids, Flagellates, Resource factors, Cropping factors, Nutrient limited growth.

A continuum may exist between waters defined as streams or lakes. In small lakes with high runoff, factors limiting phytoplankton production, termed 'resource factors' may be secondarily important if considerable planktonic biomass is removed by flushing. With light intensities corrected to a standard level, primary production in Marion Lake, British Columbia, varies inversely with rates at which water enters. Increased flushing reduces phytoplanktonic biomass, thereby lowering lake's total primary productivity, with seasonal variations in rainfall greatly influencing annual productivity of phytoplankton. Lake water artificially enclosed by plywood containers (3.05 meters square) within small areas of the lake, produced blooms principally composed of larger green algae, while phytoplanktonic biomass in surrounding lake water remained low. In Marion Lake, nannoplankton ap-

parently have a selective advantage as compared with larger, more slowly reproducing species. The ratio, production/biomass (P/B), may be useful in establishing whether resource or cropping factors have greater influence on instantaneous rates of productivity in lakes. Although a lake may apparently be highly oligotrophic, tests of possible limiting nutrients or other resources may have little value if both species composition and P/B clearly indicate that cropping factors limit primary productivity. (Eichhorn-Wisconsin)

W70-03325

LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR,

Minnesota Univ., Minneapolis. School of Public Health; and Minnesota Univ., Duluth. Dept. of Biology.

Theodore A. Olson, and Theron O. Odlaug. Great Lakes Research Division, The University of Michigan, Publication No 15, p 109-118, 1966. 2 fig, 5 tab, 5 ref.

Descriptors: *Limnology, *Lake Superior, Productivity, Crustaceans, Chlorophyll, Carbon, Depth, Seasonal, Light penetration, Biomass, Water measurement, Carbon radioisotopes, Energy, Trophic level, Water quality, Ecosystems, Zooplankton, Phytoplankton, Tracers, Sampling, Volume, Daphnia, Weight, Standing crop, Grazing, Thermocline, Temperature, Primary productivity.

Identifiers: Larsmont-Knife River (Minn), Limnocalanus macrurus, Bosmina coregoni, Daphnia pulex, Daphnia longispina, Polyphemus pediculus, Leptodora kindtii, Dinobryon sertularia, Coccochloris elebens, Asterionella formosa, Crucigenia tetrapedia, Cyclotella Kutzingiana, Synedra acus.

This summer period study, concerned with 1964 Lake Superior productivity estimates, is based on total plankton counts, abundance of plankton crustacea, quantity of chlorophyll and carbon fixation values found in water samples from the Larsmont-Knife River area. Counts of centrifuged plankton ranged from 21 to 55 organisms/milliliter. At the 5-meter level, minimum was 21 organisms and maximum 48; at 10 meters, range was 29 to 45. Crustacean counts varied with advancing season and depth. Counts obtained by Clarke-Bumpus (C-B) hauls varied from 39 (July 16) to 9,177 organisms per C-B scale unit (August 13). At 10-meter level, daylight counts ranged from 437 (July 16) to 9,177 (August 13) per C-B unit. At 30 meters, well below the 1% light transmission level, daylight counts were 51 and night counts 30 organisms/scale unit. One observation (August 6) showed the number at 30-meter depth can reach the level of one organism/7 liters. Chlorophyll varied from 0.5 milligrams (July 28) to 3.2 (August 4) per cubic meter. Concentration also varied with depth and water mass. Carbon fixation values (C-14 technique) varied from 0.13 to 0.73 milligrams carbon fixed/cubic meter per hour. (Jones-Wisconsin)

W70-03326

CHIRONOMIDA AND THE STUDY OF LAKE TYPES,

Franz Lenz.

Die Naturwissenschaften, Vol 13, p 5-10, 1925. 12 ref.

Descriptors: *Lakes, Limnology, Eutrophication, Oligotrophy, Nutrients, Basins, Dystrophy, Oxygen, Depth, Sedimentation, Plankton, Dissolved solids, Metabolism, Respiration, Nitrogen, Phosphorus, Calcium, Humus, Biological communities, Ecology, Temperature, Ponds, Streams.

Identifiers: *Chironomida, *Lake types, Tanytarsus, Mesotrophy, Polytropy, Fauna, Lauterbornia coracina, Prodiamesa bathyphila, Monodiamesa bathyphila, Mysis relicta, Norway, Finland, North Germany, Lunzer Untersee, Vierwaldstatter See, Didiaes miriforceps, Sergentia, Polypedilum, Stictochironomus, Einfelder See (Holstein), Einfeldia insolita Kieffer, Chironomus plumosus,

Chironomus bathophilus, Lenzia, Pentapedilum, Sweden.

An outline of the role played by Chironomida in lake characteristics, systematics, and solutions to problems is given. Most eutrophic lakes belong to the Chironomus lake type; all oligotrophic lakes are Tanytarsus lakes. Oxygen content of deep water plays the major role in regulating colonization. All factors contained in the milieu spectrum can exert an influence on members of the biocoenosis whether they directly promote, inhibit, or disturb life functions or indirectly change environment. That Chironomidae do not uniformly colonize the depths of Tanytarsus lakes is affirmed. Their components can be associated with different biocoenoses and can occur in different intensities. Lakes' character can be altered decisively in any direction by change in primary factor complex, or milieu spectrum. Variation in composition of the Chironomida fauna in Tanytarsus lakes may be based on different causes. Definite forms have developed or colonized with adaptation to specific characteristics. Factors which determine the environment influence the elimination of certain forms, then other types, having a greater adaptation range, can assume their place. (Jones-Wisconsin)

W70-03327

ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, Wisconsin Univ., Madison. Dept. of Entomology. William L. Hilsenhoff, and Richard P. Narf. Annals of the Entomological Society of America, Vol 61, No 5, p 1173-1181, Sept 1968. 4 fig, 4 tab, 5 ref.

Descriptors: *Ecology, *Benthos, *Wisconsin, *Lakes, Copepods, Hydrogen ion concentration, Organic matter, Mud, Eutrophication, Thermocline, Profundal zone, depth, Sampling, Temperature, Oxygen, Oxidation-reduction potential, Light intensity, Suspended load, Nitrates, Ammonia, Phosphorus, Iron, Crustaceans.

Identifiers: *Chironomidae, *Chaoboridae, Chironomus plumosus, Procladius, Chaoborus punctipennis, Chaoborus albus, Palpomyia, Ostracoda, Chironomus 'A', Chironomus staegeri, Chironomus 'C', Chironomus attenuatus, Clear water, North America, Taxonomic key, Chironomus tentans, Chironomus 'D', Chironomus atroviridis, Chironomus paganus, Chironomus 'B'.

Benthos ecology in the profundal zones of 14 Wisconsin lakes was studied for three years. Chironomid larva were reared to the imago for identification, and a key to species of Chironomus larvae constructed. Population of 10 species of Chironomus, Procladius, three species of Chaoborus, Palpomyia, Ostracode, and Copepoda were determined from monthly samples and correlated with 14 physical and chemical characteristics, to determine possible relationships. Chironomus plumosus (L), Procladius larvae, and Ostracoda occurred in the same lakes, and this incidence was positively correlated with a high pH of the mud and negatively related with the amount of organic matter in mud. Presence of C attenuatus Walker and Palpomyia larvae was correlated with clear water. Chironomus 'A', C staegeri Lundbeck, and Chironomus 'C' were most common in the same lake. Chaoborus punctipennis (Say) larvae were frequent in lakes forming a summer thermocline, and Copepoda were abundant in the most eutrophic lakes. Details on specie occurrence are given, with notes on rarer insects in the profundal zones. The third most plentiful insect family in the profundal mud was Ceratopogonidae. (Jones-Wisconsin)

W70-03328

LAKE MICHIGAN BEACH SURVEY 1968.

Illinois State Sanitary Water Board, Springfield. For primary bibliographic entry see Field 05C.
W70-03329

Field 02—WATER CYCLE

Group 2H—Lakes

BIOLOGICAL N2 FIXATION IN LAKES,
Wisconsin Univ., Madison. Water Resources
Center.
For primary bibliographic entry see Field 05C.
W70-03429

**SUBAERIAL CEMENTATION AND SUB-
SEQUENT DOLOMITIZATION OF LACUS-
TRINE CARBONATE MUDS AND SANDS
FROM PALEO-TUZ GOLU ('SALT LAKE'),
TURKEY,**
Heidelberg Univ., (West Germany). Sediment
Research Lab.
For primary bibliographic entry see Field 02J.
W70-03446

**LABORATORY COMPARISONS OF FRESH-
WATER AND SALT-WATER WHITECAPS,**
Michigan Univ., Ann Arbor. Dept. of Meteorology
and Oceanography; and Northern Michigan Univ.,
Marquette.
For primary bibliographic entry see Field 01B.
W70-03451

**NEPHEOID LAYERS AND BOTTOM CUR-
RENTS IN THE ARCTIC OCEAN,**
Lamont-Doherty Geological Observatory,
Palisades, N.Y.
For primary bibliographic entry see Field 02L.
W70-03463

**A GRAIN SIZE ANALYSIS OF LONGSHORE-
BARS AND TROUGHS, LAKE SUPERIOR, ON-
TARIO,**
Lakehead Univ., Port Arthur (Ontario).
John S. Mothersill.
Journal of Sedimentary Petrology, Vol 39, No 4, p
1317-1324, Dec 1969. 8 p, 9 fig, 11 ref.

Descriptors: *Lakes, *Sediments, *Beaches, *Lake
Superior, Sampling, Mapping, Mathematical studies,
Statistical methods, Waves (Water), Petrology,
Laboratory tests, Shores, Geology, Glaciation,
Clays.
Identifiers: Lake beach sedimentation.

Grain size analyses of 186 samples from the axes of longshore-bars and troughs along the lake shelf at Batchawana Bay and Pancake Bay, Lake Superior, Ontario, show the longshore-bar sands to be better sorted and finer grained than the adjacent shoreward longshore-trough sands. In addition the longshore-bar sands are unimodal and tend to be positively 'skewed' whereas the longshore-trough sands may be either unimodal or bimodal and show a tendency towards negative skewness. This would suggest that the longshore-troughs were formed by the action of breaking waves that preferentially set the finer grained particles into motion. These finer grained particles were then moved lakeward by the undertow to form the longshore-bar areas.
(Gabriel-USGS)
W70-03472

**THE MAGNETIC SPHERULES IN SEDIMENTS
OF LAKE MENDOTA, WISCONSIN,**
Toronto Univ. (Ontario). Dept. of Geology; and
Wisconsin Univ., Madison. Dept. of Geology and
Geophysics.
For primary bibliographic entry see Field 05B.
W70-03504

**PRELIMINARY STUDIES OF ZOOPLANKTON
DISTRIBUTION WITH THE CONTINUOUS
PLANKTON RECORDER,**
Minnesota Univ., Minneapolis. Water Resources
Research Center.
Wayland R. Swain, Theodore A. Olson, and
Theron O. Odlaug.
Available from the Clearinghouse as PB-189 294,
\$3.00 in paper copy, \$0.65 in microfiche. Water
Resources Research Center, Minnesota University,
Minneapolis, WRRC Bulletin 7, Nov 1968. 21 p, 14
fig, 11 ref. OWRR Project A-011-MINN.

Descriptors: *Zooplankton, *sampling, *Lakes,
*Biogeography, Great Lakes, Lake Superior, Lake
Michigan, Minnesota, Illinois, Indiana, Species
composition, Data acquisition, Limnology,
Copepods, Cladocera, Phytoplankton, Diatoms.
Identifiers: *Hardy Continuous Plankton Recorder,
Scottish Marine Biological Ass, Duluth (Minn),
Chicago (Ill), Two Harbors (Minn), Gary (Ind),
Patchiness, Plankton abundance, S S Cason J Cal-
laway, Diatomids, Mysis oculata relicta, Limno-
calanus macrurus, Diaptomus, Senecella, Daphnia
pulex, Daphnia longispina, Bosmina corrigoni,
Bosmina longirostris, Tabellaria fenestrata,
Asterionella formosa.

The Hardy Continuous Plankton Recorder concentrates net plankton on a continuously unrolling belt of silk bolting cloth, which intercepts a stream of water diverted through the sampler. Originally devised for use in the North Sea, the device has potential application in large fresh bodies of water. The sampler, towed by a commercial ore carrier, was tested over regular shipping routes in Lakes Superior and Michigan, sampling a transect 1/2-inch square and 300-500 miles long. Procedures are described for enumeration of plankton accumulated on the silk belts. Variations in abundance and species composition were noted between different areas of the lakes, such regional differences contributing to typical 'patchiness' of zooplankton distribution. Ratio of observed Copepoda to Cladocera is about 5:1. Limnoalanus macrurus was the predominant copepod, while species of Diaptomus also contribute significantly. Marked daily variations in both abundance and faunal composition existed at depths of 10 meters, with maximum density occurring during hours of darkness. Large localized areas with abundant phytoplankton—largely the diatom Tabellaria fenestrata, but including Asterionella formosa in smaller numbers—were also encountered. (Eichhorn-Wisconsin)
W70-03506

**I. PRODUCTIVITY: PRIMARY PRODUCTIVI-
TY STUDIES IN LAKE TAHOE, CALIFORNIA,**
California Univ., Davis. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-03508

**PRESIDENT'S LECTURE: LIMNOLOGY, SO-
CIAL WELFARE, AND LAKE KINNERET,**
Uppsala Univ. (Sweden). Inst. of Limnology.
Wilhelm Rodhe.
Verh Internat Verein Limnol, Vol 17, p 40-48 Nov
1969. 12 ref.

Descriptors: *Limnology, *Social needs,
Ecosystems, Sampling, Seiches, Depth, Stratification,
Winds, Temperature, Epilimnion, Thermocline,
Hypolimnion, Phytoplankton, Chemical analysis,
Zooplankton, Light penetration, Primary productivity,
Carbon radioisotopes, Computer programs,
Reservoirs, Political aspects, Eutrophication,
Sewage, Effluents, Bottom sediments,
Biochemical oxygen demand, Inorganic compounds,
Nutrients, Lake Erie, Lake Ontario, Lake Michigan,
Nitrogen, Productivity, Water quality,
Industries, United Nations.

Identifiers: *Lake Kinneret (Israel), Beit Netufa
(Israel), Winnipeg (Canada), Lake Zurich (Switzerland),
Lake Baikal, Lake Washington (Wash),
Seattle (Wash), Sweden, Lake Malaren (Sweden),
World Health Organization.

In limnology each component is regarded a link in the ecosystem and the entire ecosystem a product of sources and surroundings. Sound water policy must be included in the social planning of every community and industry and the cost of clean waters must be met. The difficulty lies in the failure of politicians to recognize limnological advances and act on them on a global concept. Israel's Lake Kinneret Research Project requires regular sampling of basic data: three 'isothermal samples' at each station are necessary to represent lower epilimnion, steepest thermocline, and upper hypolimnion, and, with samples close to the surface and bottom, make a weekly load of 35 samples

from seven stations for chemical analyses and quantitative determinations of phytoplankton and zooplankton. At one station, a series of samples from 5 or 3 depths will be preserved for information concerning vertical distribution of plankton. Measurements of light penetration and carbon-14 exposures are made to determine primary production. Continuous meteorological and hydrological records are indispensable for interpretation of seiches and other dynamic phenomena. Augmentation of the study of Lake Kinneret and its tributaries with the work at MEKOROT laboratory at Beit Netufa reservoir is intended. (Jones-Wisconsin)
W70-03509

**NITROGEN METABOLISM IN LAKES. II.
ROLE OF NITROGEN FIXATION IN SAN-
CTUARY LAKE, PENNSYLVANIA,**
Pittsburgh Univ., Pa. Dept. of Biological Sciences.
For primary bibliographic entry see Field 05C.
W70-03511

**THE SHAGAWA LAKE, MINNESOTA,
EUTROPHICATION RESEARCH PROJECT,**
Federal Water Pollution Control Administration,
Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05C.
W70-03512

**COMPARATIVE HYDROCHEMICAL CHARAC-
TERISTIC OF RESERVOIRS - COOLERS OF
STATE REGIONAL ELECTRIC POWER
(HEAT) STATIONS OF THE UKRAINE (In Russian),**
Akademija Nauk URSR, Kiev. Instytut
Hidrobiologii.
For primary bibliographic entry see Field 05C.
W70-03539

**HORIZONTAL AND VERTICAL DISTRIBU-
TION OF TEMPERATURE, OXYGEN, pH AND
WATER MOVEMENTS IN SLAPY RESERVOIR
(1958-1960),**
Ceskoslovenska Akademie Ved, Prague.
Hydrobiological Station.
J. Hrbacek, and M. Straskraba.

Hydrobiological Studies 1, Academia Publishing
House of the Czechoslovak Academy of Sciences,
Prague, p 7-40, 1966.

Descriptors: *Temperature, *Reservoirs, Lakes,
*Hypolimnion, Epilimnion, *Thermal stratification,
Water circulation, Dissolved oxygen, Thermal properties,
Alkalinity, Hydrogen low concentration,
Water quality.
Identifiers: Czechoslovakian reservoirs, Slapy
reservoir (Czechoslovakia).

The Slapy Reservoir on the Vltava River is narrow, long and deep, (mean width 313 m, length 42 km, max. depth 53 m). The ratio of volume to mean inflow indicates a mean renewal time of 38.5 days. A comparison of temperatures of the inflow, outflow and surface of the reservoir shows that the mean renewal time of the surface layers is much less than in lakes of a comparable drainage. During high flows, the release of water from the very deep layers is followed even in summer by horizontal currents, the velocity of which is at a distance of 9.1 km from the dam several decimeters per second. This characteristic of the deeper layers of the reservoir, when compared with lakes, is also manifested by an increase in oxygen in the deep layers during the second half of the summer, without inducing the homoiothermal conditions.
(Novotny-Vanderbilt)
W70-03541

**HYPOLIMNETIC HEATING IN CASTLE LAKE,
CALIFORNIA,**
California Univ., Davis. Dept. of Zoology.
For primary bibliographic entry see Field 05A.
W70-03551

Erosion and Sedimentation—Group 2J

2I. Water in Plants

ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIOIODINE ABSORPTION,
Montana Univ., Missoula. School of Forestry; and
Montana Univ., Missoula. Dept. of Chemistry.
Thomas J. Nimlos, Wayne P. Van Meter, and Lewis
A. Daniels.
ECOLOGY, Vol 49, No 6, p 1146-1151, Autumn
1968. 4 tab, 1 fig, 14 ref.

Descriptors: *Runoff, *Root zones, Root systems,
Plant growth.
Identifiers: *Rooting patterns, *Understory plants,
Radioiodine, Moisture regimes.

The rooting patterns of understory plants were determined with minimal disturbance of the site by injecting radioiodine into the soil and the beta and gamma activity of the aboveground tissue measured with a Geiger-Mueller detector. Injections were made to 72 inches in a clay, stone-free soils. Modifications of the procedure are required for injections to depths greater than 36 inches in stony soils. The procedure was applied to two sites of different moisture regimes. Many of the species studied rooted to 72 inches though the amount of aboveground tissue was only a few grams. Rooting on dry sites was deeper than at the more mesic site.
W70-03626

2J. Erosion and Sedimentation

LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-03255

A NEW RECORDING TURBIDITY METER FOR RIVERS,
Natal Univ., Durban (South Africa).
For primary bibliographic entry see Field 07B.
W70-03277

AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (Netherlands).
A. M. Winkelmoen, W. Van der Knaap, and R. Eijpe.
Sedimentology, Vol 11, No 3-4, p 183-196, Dec
1968. 14 p, 10 fig, 6 ref.

Descriptors: *Analytical techniques, *Particle shape, *Petrofabrics, Sediments, Optical properties, Petrography, Sedimentary rocks, Instrumentation, Photography, Sedimentary petrology.
Identifiers: Particle orientation, Optical techniques.

A new method for the measurement of grain orientation in clastic sediments is based on the principle that when an inclined beam of light passes through an elliptical hole in a plate, the amount of light passing through fluctuates with the orientation of the long axis of the ellipse. Such fluctuations are larger the greater the eccentricity of the ellipse, the amount of light passed being maximal when the long axis coincides with the plane of incidence of the light. If the plate contains many holes, which can be approximated by ellipses, their main orientation direction can be inferred from the maximum intensity of passed light. Results of a similar kind can be obtained by using a black and white picture of grain packing, obtained either from thin-sections or from printed replicas of etched polished sections of impregnated samples. The resulting data represent an integrated orientation pattern instead of a long-axis distribution pattern as given by the grain-by-grain counting technique. The new method has been thoroughly checked against the visual counting method. Excellent agreement was observed. (Knapp-USGS)

W70-03282

WEATHERING AND ROUNDNESS OF QUARTZ SAND GRAINS,
Australian National Univ., Canberra. Dept. of
Geology.
Keith A. W. Crook.

Sedimentology, Vol 11, No 3-4, p 171-182, Dec
1968. 12 p, 1 fig, 3 plate, 21 ref, 1 append.

Descriptors: *Particle shape, *Sands, *Quartz, Solubility, Corrosion, Weathering, Diagenesis, Climates, Soil formation, Soil chemistry, Sediments, Sedimentary petrology.
Identifiers: Quartz grain solution.

Photographs and descriptions of quartz sand grains from soils, paleosols and silcretes show that grain shape can be modified by solution in situ. Dissolution is attributed to solutions rich in organic molecules present in weathering profiles, and commonly results in rounding of protuberances and re-entrants on grains. The incidence of this process may vary with climate. It is postulated that solution rounding during weathering plays an important role in shaping quartz sand grains in general, its significance varying with climate. This postulate, which remains unconfirmed, has considerable implications for the interpretation of textural maturity of sandy sediments. If true, super-mature sands may be as much a climatic indicator as an indicator of tectonic quiescence. (Knapp-USGS)
W70-03283

INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE,
Kiel Univ. (Germany). Geological Inst.

For primary bibliographic entry see Field 02L.
W70-03284

DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES,

Durham Univ. (England). Dept. of Geology.
P. B. Attewell, D. M. Hirst, and R. K. Taylor.
Sedimentology, Vol 11, No 3-4, p 237-247, Dec
1968. 11 p, 6 fig, 2 tab, 17 ref.

Descriptors: *Diagenesis, *Carbonate rocks, *Calcite, *Clay minerals, *Petrofabrics, Stratification, Beds, Stress, Pressure, Water chemistry, Laboratory tests, Petrology, Petrography, Sedimentary petrology.
Identifiers: Particle orientation, Recrystallization.

Results of X-ray textural studies of dolomite and the clay minerals in the Marl Slate and of siderite from the top of the Mansfield Marine Band are interpreted in terms of the possible diagenetic development of the re-crystallized carbonates in these two rocks. From computer processed fabrics of the two trigonal carbonates it is deduced that there is a c-axis preferred orientation concordant with the normal to the stratification. An early diagenesis in this oriented mode must be a function of both a threshold stress difference in a non-hydrostatic stress field (in effect a necessary minimum depth of burial) and also of the presence of connate solutions. The existence of a minor percentage of dolomite oriented with the rhomb faces parallel to the stratification probably reflects an even earlier crystallization within the top few meters of sediment, when the confining pressures and pressure differences were of insignificant amplitude. It is concluded that a higher rate of sedimentation associated with the Coal Measure sequence is responsible for the singular preferred orientation of the siderite. (Knapp-USGS)
W70-03285

X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS,

Georgia Univ., Sapelo Island. Marine Inst.

James D. Howard.
Sedimentology, Vol 11, No 3-4, p 249-258, Dec
1968. 10 p, 5 fig, 17 ref.

Descriptors: *Sedimentary petrology, *Laboratory tests, *X-ray analysis, *Burrows, Aquatic animals, Sedimentary structures, Sediments, Deposition (Sediments).

Identifiers: Bioturbation.

Examination of the primary sedimentary texture of rocks and sediments by X-radiography can be extended to include the study of bioturbation and burrowing by living organisms. This technique involves making time-lapse X-radiographs while the animals are in the process of disturbing the sediment. Artificially and naturally stratified sediments are contained in plexiglass aquaria connected to a continuously flowing seawater system. The burrowing animals to be studied are introduced into these aquaria and the effect of their activities on the sediments is recorded by X-radiography over a period of hours, days or weeks. (Knapp-USGS)
W70-03286

PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING,

Gulf Research and Development Co., Pittsburgh, Pa.

John C. Ludwick, and Patricia L. Henderson.
Sedimentology, Vol 11, No 3-4, p 197-235, Dec
1968. 39 p, 11 fig, 1 plate, 7 tab, 21 ref.

Descriptors: *Particle size, *Sieve analysis, *Statistical methods, *Calibrations, Histograms, Frequency analysis, Probability, Mathematical models, Laboratory tests, Test procedures, Sedimentology, Sediments, Sands, Sedimentary petrology.
Identifiers: Sieve performance analysis.

Accurate particle-size measurement by sieving requires that consideration is given to particle shape and screen opening size variations. The effect of particle shape has been studied by determining experimentally the probability of passage through each of 5 woven-wire screens of 35 different mm-sized ellipsoids. These range in shape from $T/D = 0.2$ to 1.0 and from $L/D = 1.125$ to 2.625 , where T is particle thickness, L is particle length, and D is particle intermediate diameter. A mathematical sieving theory stemming from the idea of particle passing probability is developed and tested by computer-simulated sieving of idealized input samples of simple shape composition. When near-spheres are sieved a bar-type histogram results. For some other more realistic shape inputs, broad, overlapping bell-shaped fraction distributions result, considerably different from the nominal openings of the limiting screens. For these distributions, conventional representation in histogram form is incongruous. (Knapp-USGS)
W70-03287

TEXTURAL STUDIES OF GRADING: VOLCANIC ASH FALLS,

Illinois Univ., Urbana; and Indiana Univ., Bloomington.

Adrian E. Scheidegger, and Paul Edwin Potter.
Sedimentology, Vol 11, No 3-4, p 163-170, Dec
1968. 8 p, 2 fig, 8 ref, 1 append.

Descriptors: *Aeolian soils, *Graded, *Beds, *Volcanoes, *Geomorphology, Aggradation, Deposition (Sediments), Sedimentation, Sedimentology, Stratification, Sedimentary structures, Sediment transport, Turbulent flow, Diffusivity, Sedimentary petrology.
Identifiers: *Graded bedding, *Ashfalls (Volcanic).

A theory of the lateral decrease of grain size and bed thickness with increasing distance of downwind transport is developed for ash falls. The theory is based on the sediment load density of a turbulent slug of fluid, a turbulent diffusivity coefficient, and the decay of turbulent velocity fluctuations. All three factors are founded on empirical observation and are generally accepted as having widespread applicability to turbulent sediment-fluid mixtures. The theory yields good qualitative agreement with observational data. (Knapp-USGS)
W70-03288

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER-POINTBAR DEPOSITS, LOWER RHINE),

Utrecht Rijksuniversiteit (Netherlands). Geological Inst.; and State Geological Survey, Haarlem (Netherlands).

J. R. Boersma, E. A. Van de Meene, and R. C.

Tjalsma.

Sedimentology, Vol 11, No 3-4, p 147-162, Dec 1968. 16 p, 9 fig, 9 ref.

Descriptors: *Ripple marks, *Dunes, *Sedimentary structures, *Sand waves, Currents (Water), Eddies, Vortices, Turbulent flow, Meanders, Bed load, Alluvial channels, Sediment transport, Channel morphology, Sedimentary petrology.

Identifiers: Megaripples, Rhine River, Cross-stratification, Forest beds.

Of several uncommon types of large-scale cross-stratification encountered in Late Holocene upper-pointbar sandy deposits of the Rhine, one is examined in detail. This type is structurally bipartite as it consists of a relatively coarse-grained, upper interval of large-scale foresets, which indentate with the oppositely dipping small-scale foresets in the underlying finer interval. The interwoven set is regarded as formed by a mega ripple (dune) with, in front of it, a simultaneously active system of small-scale, oppositely moving, ripples propelled by the backflow branch of the mega ripple's lee-side vortex. Comparison of dip, strike, and principal bedding-plane sections brought to light dissimilarity in the crestline orientations of the mega-ripple and backflow-ripple systems. The latter's oblique, or incidentally perpendicular orientation with respect to the mega-ripple front indicates a conspicuous component of lateral water movement, which in the present outcrop was consistent from left to right looking down stream. It is suggested that this lateral water movement is due to the radial (transverse) flow in the bend of a meandering river. From the sense of the radial flow the river's bend configuration can be inferred. (Knapp-USGS)

W70-03289

HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN,

Louisiana State Univ., Baton Rouge.

Norman C. Rosen.

Journal of Sedimentary Petrology, Vol 39, No 4, 1552-1565, Dec 1969. 14 p, 6 fig, 1 tab, 53 ref.

Descriptors: *Sedimentary petrology, *Provenance, *Mineralogy, *Mississippi River, *Gulf Coastal Plain, Geomorphology, Sedimentation, Sediment transport, Erosion, Particle size, Pleistocene epoch.

Identifiers: Heavy mineral analysis, Citronelle Formation.

The heavy minerals of the Citronelle Formation and fluviatile terraces of Louisiana were examined to determine the source of these sediments. An East Gulf Province heavy mineral suite (kyanite, staurolite, zircon, tourmaline), typical of the Cretaceous and Tertiary sediments of the Gulf Coastal Province is present throughout the Citronelle and older Louisiana terrace deposits. A Mississippi River province suite (epidote, dolomite, amphibole-pyroxene, garnet), presumably derived from the glacial deposits of the northern United States, is present in the younger Louisiana terrace deposits. The Citronelle Formation appears to represent an alluvial apron formed by coalescing, braiding streams in response to epeirogenic uplift of the continental interior during Late Pliocene time. Encision of the Mississippi River and other streams into Citronelle sediments resulted in entrenched valleys containing fluviatile terraces which are mineralogically and lithologically similar to the Citronelle but are at lower elevations. Younger terrace deposits bearing a Mississippi River province heavy mineral suite are believed to have formed in response to fluctuat-

ing sea level during the Pleistocene. (Knapp-USGS)
W70-03445

SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRISE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ('SALT LAKE'), TURKEY.

Heidelberg Univ., (West Germany). Sediment Research Lab.

German Muller, and Georg Irion.

Sedimentology, Vol 12, No 3/4, Special Issue, p 193-204, June 1969. 12 p, 11 fig, 7 ref.

Descriptors: *Dragenesis, *Carbonate rocks, *Dolomite, *Limestones, *Playas, Lakes, Water chemistry, Calcium, Magnesium, Carbonates, Chemical precipitation, Geochemistry, Sedimentary rocks.

Identifiers: *Turkey, Anatolia, Tuz Golu.

Along the eastern coast of the Gez Golu, a salt lake formerly belonging to the larger 'Paleo-Tuz Golu' in central Anatolia, about 6.5 m of lake sediments of probably Pleistocene age were studied. The sediment series consists of fine-grained unconsolidated dolomite muds representing the basin sedimentation of the old lake. Nine lithified beds (omicrites, intramicrites, intraoomicrites, intrabimicrites and dololutites with smaller amounts of allochems) are intercalated. These beds were deposited in very shallow water in the littoral zone of the paleo-lake. The beds were occasionally exposed to the air after deposition. This led to desiccation (with mud cracks, breaking up of intraclasts) and subaerial cementation due to the influx of fresh water. These now lithified carbonate sedimentary rocks were submerged and subsequently covered with mud. During this sub-aquatic phase the rock beds as well as the unconsolidated muds were dolomitized by an extremely high Mg/Ca-ratio (150/1) of the lake water. Dolomitization may have taken place or was initiated during the subaerial phase. (Knapp-USGS)

W70-03446

STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS,

Technische Universitaet, Berlin (West Germany). Inst. of Geology and Paleontology.

H. Zankl.

Sedimentology, Vol 12, No 3/4, Special Issue, p 241-256, June 1969. 16 p, 7 fig, 28 ref.

Descriptors: *Diagenesis, *Carbonate rocks, *Water chemistry, Sedimentation, Chemical reactions, Calcium, Magnesium, Carbonates, Chemical precipitation, Geochemistry, Sedimentary rocks.

Identifiers: Carbonate sediment lithifications, Lime muds.

Absence of compaction, intraformational breccias, resedimentation, internal sediments and synsedimentary hardgrounds indicate early lithification of finegrained carbonate rocks. One of the factors controlling early lithification is the purity of lime mud. Less than 2% of insoluble residue (especially clay minerals) favors cementation and recrystallization before further sediment accumulation causes compaction. Thus, early lithification is terminated in or near the environment of sedimentation. Electrochemical reactions are considered to be possible mechanisms for cementation. (Knapp-USGS)

W70-03447

CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, Illinois Univ., Urbana. Dept. of Geology.

For primary bibliographic entry see Field 08E.

W70-03448

SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA,

Geological Survey, Worland, Wyo.

Hugh W. Lowham.

Geological Survey Open-file Report, Nov 1969. 20 p, 7 fig, 2 tab.

Descriptors: *Sediment transport, *Bed load, *Montana, *Wyoming, Sands, Sedimentation, Erosion, Sediment yield, Irrigation water, Return flow, Streamflow, Scour, Silting.

Identifiers: Big Sand Coulee (Wyo-Mont).

The erosion of streambanks and basin surface by storm and snowmelt runoff provides large amounts of sediment to streams in the Big Sand Coulee basin, Montana and Wyoming. Some sediment is carried into the Clarks Fork Yellowstone River and some is deposited in the channel of Big Sand Coulee. Small amounts of sediment are brought into the Big Sand Coulee by waste waters from the Heart Mountain Irrigation Project and from other irrigated lands. These waters pick up sediment from the streambed of Big Sand Coulee and transport it downstream but do not appear to be causing any accelerated erosion. Waste waters, return irrigation water, and groundwater inflow maintain a continuous flow and transport sediment continuously into Clarks Fork Yellowstone River. (Knapp-USGS)

VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE BLAKE PLATEAU,

National Oceanographic Office, Washington, D.C. Deep Vehicles Branch.

Larry K. Hawkins.

Journal of Geophysical Research, Vol 74, No 28, p 7009-7017, Dec 20, 1969. 9 p, 10 fig, 6 ref.

Descriptors: *Deposition (Sediments), *Manganese, *Oceans, Sea water, Submarines, Topography, Phosphates, Currents (Water), Mapping, Waves (Water), Geology, Carbonates, Environment.

Identifiers: Blake plateau, Submarine manganese deposits.

Visual observations of manganese deposits on the Blake plateau from a manned submersible indicate that the occurrence of manganese as nodules, slabs, or pavement may be related to localized environmental conditions. Manganese is concentrated at the crests of sand waves and, in areas of gentle slope, grades locally from nodules to solid pavement. (Gabriel-USGS)

W70-03462

THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS,

Rensselaer Polytechnic Inst., Troy, N.Y. Dept of Geology.

For primary bibliographic entry see Field 02K.

W70-03468

GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R.,

National Research Center, Cairo (Egypt). Earth Science Lab.

For primary bibliographic entry see Field 02L.

W70-03469

A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS,

Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology.

For primary bibliographic entry see Field 07B.

W70-03470

IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO,

Texas Instruments, Inc., Dallas; and Kansas Univ., Lawrence. Dept. of Civil Engineering.

Jerry A. Watson, and Ernest E. Angino.

Chemical Processes—Group 2K

Journal of Sedimentary Petrology, Vol 39, No 4, p 1412-1419, Dec 1969. 8 p, 4 fig, 2 tab, 18 ref.

Descriptors: *Sediments, *Diagenesis, *Iron, Geochemistry, Gulf of Mexico, Water chemistry, Stratification, Sea water, Manganese, Cobalt, Trace elements, Pleistocene epoch, Carbon radioisotopes, Cores, Climates, Geology, Mapping, Analytical techniques, Statistical studies, Sampling, Carbonates.

Identifiers: Iron-rich sediments.

Thin yellow layers (0.5 to 2 cm) examined in seven cores in the west and central portions of the Gulf of Mexico are enriched in iron, manganese, cobalt, and nickel with respect to the surrounding sediments. The average enrichment is 66, 33, 51, and 28 percent, respectively. The highest correlation coefficients between single pairs of elements yield Co:Ni ($r = 0.53$), Fe:Ni (0.64), Fe:Co (0.62), and Mn:Co (0.50). The yellow, iron-rich sediments commonly occur in the Pleistocene-Holocene transition zone and in the upper Pleistocene sediments. The iron-rich zones are considered to be the result of a reduced sediment accumulation rate. Carbon-14 dates support this argument. The close association with iron-stained foraminiferal tests in the sediments suggests post-depositional scavenging. The yellow layers are most prevalent on the lower continental slope, continental rise, and Sigsbee abyssal plain. (Gabriel-USGS)

W70-03471

A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO,

Lakehead Univ., Port Arthur (Ontario).

For primary bibliographic entry see Field 02H.

W70-03472

RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES,

Wisconsin Univ., Madison.

For primary bibliographic entry see Field 02L.

W70-03478

RECENT SEDIMENTATION IN THE BERING SEA,

Akademija Nauk SSSR, Institut Okeanologii.

For primary bibliographic entry see Field 02L.

W70-03500

THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION,

Georgia Inst. of Tech., Atlanta. School of Civil Engineering.

C. Samuel Martin, and Mustafa M. Aral.

Available from the Clearinghouse as PB-189 404, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Center, Georgia Institute of Technology, Completion Report WRC-0869, Nov 1969. 97 p, 2 tab, 46 fig, 20 ref, 1 append. OWRR Project B-019-GA.

Descriptors: *Sediment transport, *Seepage, *Sediment-water interfaces, *Permeable beds, *Stream-beds, *Slope stability, *Bed load, Porous media, Permeability, Sediment load, Suspended load, Porosity, Stream channel erosion.

The research objectives were to determine the criterion governing incipient sediment motion when a plane bed is subject to seepage through it and boundary-layer flow over it, and to determine the effect of the seepage force on sediment transport. Slope instability tests were conducted with seepage flow into and out of the bed using two sand columns, one square and the other circular in cross section. For uniform sand particles ranging from 0.46 mm to 0.72 mm in diameter, the seepage force on the interfacial sand grains was determined to be one-half the seepage force on particles well within the bed. Incipient-motion tests indicate that seepage may either enhance or hinder incipient motion, depending on the relative magnitude of the boundary shear stress and seepage force, both of

which depend on seepage flow. For a given hydraulic gradient for seepage into a bed the size of the sand grains is critical regarding incipient motion. Incipient motion may be hindered for smaller sand grains but enhanced for larger sand grains. Seepage into a sand bed was found to not measurably impair sediment transport, unless fine particles are deposited in the bed. For practical values of hydraulic gradient, that is less than unity, the effect of seepage on incipient motion and sediment transport is not significant. (Conway-Georgia Tech)

W70-03617

2K. Chemical Processes

NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION,

Maryland Univ., College Park. Dept of Civil Engineering; and Federal Water Pollution Control Administration, Washington, D.C.

For primary bibliographic entry see Field 05A.

W70-03265

QUALITY OF SURFACE WATERS OF SOUTH CAROLINA: A SUMMARY OF DATA, 1945-1968,

Geological Survey, Columbia, S.C.

For primary bibliographic entry see Field 05B.

W70-03266

THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION,

Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Bedford Inst. Lab.

Trevor Platt.

Limnology and Oceanography, Vol 14, No 5, p 653-659, Sept 1969. 2 fig, 2 tab, 10 ref.

Descriptors: *Primary productivity, *Photosynthesis, Solar radiation, Oceanography, Chlorophyll, Regression analysis, Estimating equations, Photometry, Biomass, Carbon radioisotopes, Fluorometry, Correlation analysis, Inhibition, Environmental effects, Nutrients, Temperature, Light intensity.

Identifiers: *Energy efficiency, Optical extinction coefficient, Depth effects, St Margaret's Bay (Nova Scotia), Nova Scotia, Canada, Precision, Error analysis, Extinction coefficients, Biological processes, Photobiology, Biological extinction coefficients, Radiocarbon uptake technique, Chlorophyll a, Oscinodiscus excentricus, Raritan Bay (Canada), Assimilation quotients, Chemical processes.

Establishment of truly dimensionless measures of energy efficiency may make possible the comparison of primary productivity of water masses. Coefficient, k-sub-b, which measures the contribution of photosynthetic processes to the total optical extinction coefficient is defined. Based on theoretical considerations and first-order simplifying approximations, k-sub-b, at any depth, is shown to be equivalent to the ratio, primary production to incident radiation at that depth, where each is expressed in calories. Values for k-sub-b, calculated for two stations in St Margaret's Bay, Nova Scotia, show that the coefficient, at any depth, is linearly dependent on concentration of chlorophyll a at that depth. Errors in estimating k-sub-b include errors in measurement of energy fixed, of incident radiation at water's surface, and of optical extinction coefficient. Precision in estimating k-sub-b would be improved by measurement of incident radiation at any depth with an in situ integrating radiometer. K-sub-b may represent a useful index for comparison of primary productivity of waters, and that its regression on concentration of chlorophyll a can be used as a predictive tool in studies of production. (Eichhorn-Wisconsin)

W70-03313

OCCURRENCE AND SIGNIFICANCE OF IRON, MANGANESE, AND TITANIUM IN GLACIAL

MARINE SEDIMENTS FROM THE ESTUARY OF THE ST LAWRENCE RIVER,

Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Bedford Inst.

D. H. Loring, and D. J. G. Nota.

Journal Fisheries Research Board of Canada, Vol 25, No 11, p 2327-2347, 1968. 5 fig, 4 tab, 26 ref.

Descriptors: *Sediments, Iron, Manganese, Titanium, Oxidation-reduction potential, Erosion, St Lawrence estuary, Glacial soils, Estuaries.

Identifiers: Sediment texture, Oxide films, Detrital minerals, Canadian Shield, Marine sediments.

Investigations of glacial marine sediments of Canadian Shield origin revealed small but significant modification of iron and manganese-bearing material produced by the present physicochemical conditions. Titanium was not affected by environmental influences. The content of elements was related to the texture of sediments, increasing in small-size fractions. (Wilde-Wisconsin)

W70-03320

OXYGENATION OF FERROUS IRON: THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE,

Harvard Univ., Cambridge, Mass. Dept. of Applied Chemistry.

For primary bibliographic entry see Field 05B.

W70-03434

STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS,

Technische Universitaet, Berlin (West Germany). Inst. of Geology and Paleontology.

For primary bibliographic entry see Field 02J.

W70-03447

OCCURRENCE AND QUALITY OF GROUND-WATER IN SHACKELFORD COUNTY, TEXAS,

Texas Water Development Board, Austin.

For primary bibliographic entry see Field 02F.

W70-03460

VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA,

Centre National de la Recherche Scientifique, St. Cloud (France).

For primary bibliographic entry see Field 02C.

W70-03461

THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS,

Rensselaer Polytechnic Inst., Troy, N.Y. Dept of Geology.

David S. Haglund, Gerald M. Friedman, and Donald S. Miller.

Journal of Sedimentary Petrology, Vol 39, No 4, p 1283-1296, Dec 1969. 14 p, 14 fig, 4 tab, 23 ref. NSF Grants GP 2691 and GP 5169.

Descriptors: *Diagenesis, *Uranium radioisotopes, *Carbonate rocks, *Sediments, Carbonates, Sampling, Geology, Sands, Calcite, Limestones, Carbon radioisotopes, Pleistocene epoch, Stratigraphy, Mineralogy, Recent epoch, Geochemistry.

Identifiers: *Bermuda, Israel.

Recent carbonate sands and their ancient analogs were studied in Bermuda and Israel in order to establish the effect of fresh water alteration on the distribution of uranium. The uranium and calcite concentrations show an inverse relation and indicate that calcite, the product of fresh water alteration, accepts less uranium than the original aragonite. The relationship between uranium and stable carbon and oxygen isotopes for the Bermuda samples is inconclusive, whereas the same plots for the Israeli Coast samples show a direct relationship between decreasing uranium content and increasingly negative delta values. In general as the

Field 02—WATER CYCLE

Group 2K—Chemical Processes

metastable minerals aragonite and Mg-calcite are removed from the sediment system in the change from unconsolidated carbonate sand to consolidated limestone, there is a concomitant decrease in uranium content. (Gabriel-USGS)
W70-03468

DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Cunningham Lab.
For primary bibliographic entry see Field 05A.
W70-03502

2L. Estuaries

FISH AND POWER PLANTS,
New York State Dept. of Conservation, Albany.
Div. of Marine and Coastal Resources.
For primary bibliographic entry see Field 05C.
W70-03250

FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER,
Asian Inst. of Technology, Bangkok (Thailand).
Dept. of Engineering.
For primary bibliographic entry see Field 04B.
W70-03257

ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY,
John Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
W. J. Wiseman, Jr.
Chesapeake Bay Institute Technical Report 59, Reference 69-12, Johns Hopkins University, Nov 1969. 76 p, 19 fig, 1 tab, 36 ref, 1 append. Navy Proj No NR 083-016, Office of Naval Research Contract nonr 4010 (11).

Descriptors: *Current meters, *Turbulence, *Vortices, *Estuaries, Currents (Water), Streamflow, Calibrations, Instrumentation, Water circulation.
Identifiers: Doppler current meters, Acoustic current meters, Chesapeake Bay.

As part of a program to study naturally occurring fluid motions in the marine environment a meter was developed to sense high-frequency turbulence. The meter does not disturb the fluid at the point of measurement. It measures the entire velocity vector and it takes a vector average of measurements. The meter has been laboratory tested and used in the field. During the field tests, the conditions under which it was operated were far from optimal, but some useful data were obtained. At the small time scales involved there may exist significant vertical velocities in an estuary. The energy in the vertical turbulent fluctuations was less than in either horizontal direction. This rules out the possibility of isotropic turbulence at these scales of motion, for the estuarine conditions sampled. The current meter has the capability of operating effectively in the presence of a wave field. (Knapp-USGS)
W70-03259

TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
James J. Schneider.
Geol Surv Open-file Report, Jan 1969. 16 p, 6 fig, 1 tab.

Descriptors: *Tides, *Florida, *Bays, Inlets (Waterways), Sea level, Urbanization, Shores, Tidal waters, Water levels, Water level fluctuations, Surveys, Data collections, Hydrologic data.
Identifiers: Dade County (Fla), Miami (Fla).

Development of the waterfront lands of southeast Dade County depends upon the construction of sea walls (bulkheads) and filling of the lowlying land. To assist Dade County officials in planning the development of the area, an investigation was made to determine the elevation of mean high water and tidal patterns in the south Biscayne Bay area. The results of the investigation are based on records collected from 10 tide gages during the period July 1, 1967 through June 30, 1968. Prior records from most of the gages were available for correlation. The elevation of mean high water was 1.5 feet in central Biscayne Bay and 0.9 ft in the lower bays. The mean tidal range was 2.0 ft in central Biscayne Bay and 0.5 ft in the lower bays. The difference between mean half tide and mean water level was found to be negligible at all stations. The time lag for high and low tides, referred to Miami Beach, was approximately one hour in Biscayne Bay and 6 hours at Manatee Bay. (Knapp-USGS)
W70-03268

WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH),
Rijksinstituut voor Zuivering van Afvalwater, Voorburg (Netherlands).
For primary bibliographic entry see Field 05B.
W70-03269

INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE,
Kiel Univ. (Germany). Geological Inst.
Robert S. Newton.
Sedimentology, Vol 11, No 3-4, p 275-292, Dec 1968. 18 p, 7 fig, 2 plate, 1 tab, 27 ref.

Descriptors: *Ripple marks, *Waves (Water), *Sedimentary structures, Sedimentary petrology, Sedimentation, Sediment transport, Currents (Water), Sand waves, Tracers, Tracking techniques, Bed load.
Identifiers: Nearshore ripple marks.

Wave-formed ripple marks in the nearshore zones of the Baltic Sea (tideless) and North Sea (tidal) exhibit a unidirectional internal lamination identical to that of current ripples. This holds true whether the ripples are symmetrical or asymmetrical. In most cases wave-formed ripple laminae dip toward shore and can thereby provide a shoreline direction indicator when found in ancient sediments. The sediment transport direction, however, may be other than in the foreset laminae dip direction, and cross-lamination as a sediment transport direction indicator should be used with caution. Ripple height, wave length and the orientation of the ripple internal structure are dependent upon both the orbital diameter and the velocity of the positive component of oscillation of the waves forming them. The thickness of the individual laminae making up ripples is highly dependent upon sediment grain size; the role hydrodynamics plays is problematic. (Knapp-USGS)
W70-03284

CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.
Federal Water Pollution Control Administration, Edison, N.J. Northeast Region Research and Development Program.
For primary bibliographic entry see Field 05C.
W70-03349

MARITIME CONTIGUOUS ZONES,
For primary bibliographic entry see Field 06E.
W70-03381

CONSERVATION OF NATURAL RESOURCES (SHORE EROSION).
For primary bibliographic entry see Field 04D.
W70-03405

HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 02J.
W70-03445

NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
Kenneth Hunkins, Edward M. Thorndike, and Guy Mathieu.
Journal of Geophysical Research, Vol 74, No 28, p 6995-7008, Dec 20, 1969. 14 p, 8 fig, 3 tab, 15 ref. ONR Contracts Nonr 266 (82) and N00014-67-A0108-0016.

Descriptors: *Ocean currents, *Currents (Water), *Optical properties, *Turbidity, Instrumentation, Arctic Ocean, Photography, Suspension, Turbulent flow, Velocity, Topography, Water Circulation, Surface waters, Deep water, Organic matter, Mapping, Soundings, Transmissivity, Mathematical studies, Suspended load.
Identifiers: Nepheloid layers (Oceanography), Nephelometry.

Light scattering from nepheloid layers of the Arctic Ocean was investigated by using nephelometers and echo sounding. The zone of deep light scattering over oceanic ridges and rises is called the bottom nepheloid layer. At all the observation stations the strongest scattering occurred near the surface, decreasing with depth in the upper layers. The bottom nepheloid layer is evidently caused by fine material that is maintained in suspension by turbulent flow. Swifter current speeds occur over the ridges and suggest a counterclockwise deep circulation in the Canada basin. (Gabriel-USGS)
W70-03463

GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R.,
National Research Center, Cairo (Egypt). Earth Science Lab.
M. M. Kholief, E. Hilmy, and A. Shahat.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1520-1529, Dec 1969. 10 p, 6 fig, 5 tab, 37 ref.

Descriptors: *Sedimentary petrology, *Deltas, *Estuaries, *Sediments, *Sands, Mineralogy, Geology, Rivers, Sampling, Mapping, Environment, Alluvium, Silts, Clays, Particle size, Statistical methods, Chemical analysis.
Identifiers: Nile Delta.

Samples of sediments from the Nile Delta were investigated by mechanical, chemical, and mineralogical analyses. Sand islets have a general lithologic uniformity and are commonly characterized by graded bedding and ripple marks. The sands are from moderately to well sorted and exhibit no significant differences in the mean roundness of grains. Small amounts of iron oxide and carbonates coat the quartz grains. Two heavy mineral assemblages were found. (Gabriel-USGS)
W70-03469

IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO,
Texas Instruments, Inc., Dallas; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-03471

CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS,
Coast and Geodetic Survey, Rockville, Md.
George Pararas-Carayannis.
Available from US Dept of Commerce, Environ Sci Serv Admin, Coast and Geodetic Survey, World Data Center A Rep WDCA-T 69-2, May 1969. 94 p, 2 tab, 146 ref, index.

Water Yield Improvement—Group 3B

Descriptors: *Tsunamis, *Hawaii, *Data collections, *Bibliographies, Ocean waves, Waves (Water), Earthquakes, Pacific Ocean.
Identifiers: World Data Center.

All available data pertaining to tsunamis in the Hawaiian Islands are compiled. An extensive bibliography is included. All the available information has been compiled from historical accounts, newspaper archives, other reports, and recent mareographic data. Most of the events listed are associated with earthquakes, but some are associated with volcanic activity. Others, which do not show an association with earthquakes near the places of observation, may have been tsunamis of distant seismic origin for which there is no record. Most of the destructive tsunamis in the Hawaiian Islands have been generated along the coast of South America, the Aleutian Islands, the Kamchatka Peninsula, and Japan. The number of locally generated tsunamis is very small. (Knapp-USGS)
W70-03476

RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES, Wisconsin Univ., Madison.

J. Robert Moore.

Bulletin of the British Museum (Natural History), Mineralogy Series, Vol 2, No 2, p 21-131, Feb 1968. 110 p, 47 fig, 7 tab, 70 ref.

Descriptors: *Sedimentation, *Estuaries, *Bays, Petrography, X-ray analysis, Mineralogy, Chemical analysis, Trace elements, Geochemistry, Streams, Sands.
Identifiers: *Cardigan Bay (Wales).

Marine sediments in the shallow waters of northern Cardigan Bay, Wales, are dominantly fine-grained sands that have been well sorted by active tidal and longshore currents. Minor accumulations of bimodal deposits of sand and gravel are present near the sarns, and at the base of the eroding coastal cliffs. The bay deposits are composed of 6 common minerals: quartz, muscovite, chlorite, orthoclase, plagioclase, and calcite. Rarely, minor amounts of dolomite are present. Based on their gross mineral content, the deposits are classified as quartose sands, with a few being subgreywackes, or sublithic sands. Charted dispersal patterns indicate local sources along the coast, namely eroding exposures of glacial debris and sea-cliffs of slates and greywackes. Spectrochemical data are reported, and elemental distributions in the bay sediments charted. Distribution patterns of certain elements associated with accessory minerals define zones of tidal currents, while elements related to aluminosilicates largely indicate the locations of eroding coastal exposures currently supplying detritus to the bay. Most of the bay sands are derived from coastal erosion sites and not from sources inland; streams are not active suppliers of sand to the bay; estuaries are being infilled from the sea; net transport of sediment is northward inshore, but seaward, in part, offshore; and that the present bay sands would have the desirable features of a reservoir rock if they were buried in the subsurface. (Gabriel-USGS)
W70-03478

RECENT SEDIMENTATION IN THE BERING SEA,

Akademiya Nauk SSSR. Institut Okeanologii.

A. P. Litsyn.

CFSTI Translation No TT 68-50315, 1966. 614 p, 187 fig, 102 tab, 544 ref.

Descriptors: *Sedimentation, *Marine geology, Analytical techniques, Sampling, Mapping, Climates, Permafrost, Continental shelf, Continental slope, Soils, *Glaciation, Water chemistry, *Bottom sediments, Mineralogy, Petrography, Organic matter, Biogeography.
Identifiers: Bering Sea, Recent sedimentation.

The Bering Sea is one of the largest marine basins of the globe, with an area of 2,257,541 sq km. It is

also the deepest sea washing the shores of the USSR. It has a maximum depth of 4,420 m, equal to the mean depth of the Pacific and exceeding the mean depth of the World Ocean. The Bering Sea lies on the boundary between the glacial and the temperate zones. It is probably singular in this respect, making possible studies of all the details of sedimentation in these zones and the transition regions between them, as well as research into the variations of the positions of these zones in the geological past. The depth of the Kamchatka Strait exceeds the maximum depth of the sea so that Pacific Ocean waters penetrate throughout this basin. The narrow and shallow Bering Strait connects the Bering Sea with the Arctic Ocean. Its maximum depth is only 58 m, its average depth 30-50 m, and its width 85 km, and at times of low sea level the strait may have been a land bridge to North America. Marine conditions are most distinct in the northern and eastern parts of the sea, while oceanic conditions dominate in the deep basins in its southern part. The Bering Sea lies within the northern belt of Pacific diatomaceous oozes. It is therefore possible to study the results of combined effects of terrigenous and biogenic siliceous sedimentation. (Gabriel-USGS)
W70-03500

DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING,
California Inst. of Tech., Pasadena, Calif. W. M. Keck Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 08B.
W70-03553

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Economics; and Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management. F. J. Wells, and P. W. MacAvoy.
Department of State, Office of Water for Peace Report, 1969. 106 p, 14 fig, 11 tab, 30 ref, 3 append.

Descriptors: *Desalination plants, *Cost analysis, *Water costs, Economics, Economics of scale, Desalination processes, Capital costs, Construction costs, Electric power costs, Maintenance costs, Operating costs, Total costs, Cost comparisons, Discount rate.
Identifiers: Desalination costs.

A survey and an analysis were made of sea water desalination costs estimates contained in a number of source documents. These water costs components were tabulated, and then plotted in graphs as a function of plant capacity. Even for similar sized plants, wide ranges of costs were observed within most of these cost categories. Tables of results are given for the following conditions: Near-Term (MSF) Unit Water Costs; 10,000, and 1000 mgd plant sizes; 0, 3, 6, 9, and 12% interest rates; 30 year plant life; 60, 70, 80, and 90% plant load factors; 30 cents per million BTU fossil fuel cost. (Knapp-USGS)
W70-03453

RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH,
Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.
For primary bibliographic entry see Field 02F.
W70-03454

SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES,
Nebraska Univ., Lincoln. Water Resources Research Inst.

Luh C. Tao, Richard Myers, and Dennis Kos.
Available from the Clearinghouse as PB-189 403, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute Project Completion Report, Nebraska University, Jan 24, 1969. 21 p, 5 fig, 3 tab, 8 ref. OWRR Proj No A-010-NEB.

Descriptors: *Films, *Saline water, *Scaling, Heat transfer, Calcium sulfate, Evaporators, Research and development, Coatings, Boilers, Feeding rates.
Identifiers: Polyfluorocarbon boiler-tube coatings.

Desalination evaporator scaling was considerably reduced by a thin polyfluorocarbon coating on boiler tubes. Coatings of 'McLube', made by McGee Chemical Company, less than 0.001-inch thick improved the heat transfer rate about 70% to 130% relative to the uncoated tubes. The initial small boiler was then modified in order to allow continuous feed of calcium sulfate solutions. The coating performance exhibited more improvement with (1) moderate feed rates of salt solution and (2) high temperature difference across the tube wall. The results from the small boiler were confirmed in a larger pilot scale boiler. The feasibility of using a low-adhesion coating to reduce scaling on evaporators has been established. Further study on durability of coatings and possible combination with seeding the feed solution is recommended. (Carstea-USGS)
W70-03646

3B. Water Yield Improvement

BASE-FLOW STUDIES OF LEON AND LAM-PAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-03466

DIVISION OF WATER DEVELOPMENT.

NJ Stat Ann secs 58:19-4 to 58:19-8 (1966).

Descriptors: *New Jersey, *Reservoirs, *Administrative agencies, *Water supply, Dams, Water works, Planning, Water control, Legislation, Regulation, Government finance, Rivers, River flow, Gaging stations, Dam construction, Projects, Project planning, Project purposes, Domestic water, Industrial water.

The Division of Water Development is created in the Department of Conservation and Economic Development and shall consist of a five-member Board appointed by the Governor. The members shall serve without compensation for terms of from one to four years. The Board shall acquire and operate a water supply system to be known as the New Jersey Water Supply System. The System shall include a reservoir near Chimney Rock in Somerset County adequate to initially yield 70,000,000 gallons daily. Upon further authorization from the legislature the yield shall be increased to 200,000,000 gallons daily. Other reservoirs and facilities to provide increased water supply for domestic and industrial uses are authorized. The Board may expend \$60,000,000 from the proceeds of the New Jersey Water Supply Bond Act for construction of the Chimney Rock Reservoir and compensating facilities on the Raritan River to assure a minimum daily flow of 130,000,000 gallons to be measured at the Bound Brook gaging station. Remaining funds under the Act may be expended as specifically authorized by law for planning, water supply investigations, and additional facilities. (Kahl-Florida)
W70-03491

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3D—Conservation in Domestic and Municipal Use

3D. Conservation in Domestic and Municipal Use

WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS).

Ohio Rev Code Ann secs 6103.06-6103.30 (Page 1953), as amended, (Supp 1970), secs 6103.081, 6103.31 (Supp 1970).

Descriptors: *Ohio, *Water supply, *Water management (Applied), Water works, Utilities, Water distribution (Applied), Financing, Legislation, State governments, Administrative agencies, Regulation, Local governments, Sanitary engineering, Public health, Legal aspects, Sewage districts.

Procedures for the construction of proposed improvements by water supply districts are outlined in the statute. The board of county commissioners may issue and sell bonds to finance the improvement. Bids are let for the construction of the improvement to be accepted or rejected by the board. A petition to waive procedural safeguards to hasten construction may be made to the board by the landowners to be benefitted. All property benefitted by the improvement shall be ratably assessed. Methods and terms of assessment payments are outlined. Certification of assessments are made by the county auditor. The Department of Health can require improvements to be made by the board, if they believe that unsafe water conditions exist in the county. Such demands are subject to court review. Water may be supplied beyond the district. Existing private water works of good quality may be purchased by the board. Eminent domain proceedings may be brought or property may be purchased when land is needed by the board to effect the provisions of this act. (Barnett-Florida) W70-03397

WATER RESOURCES.

For primary bibliographic entry see Field 06B.
W70-03421

ACQUISITION OF LAND TO PREVENT CONTAMINATION.

For primary bibliographic entry see Field 05G.
W70-03532

3E. Conservation in Industry

OIL AND GAS.

For primary bibliographic entry see Field 08G.
W70-03425

THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES,

Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 06C.
W70-03431

COST HANDBOOK FOR INDUSTRIAL WATER USES,

Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 06C.
W70-03432

WATER SUPPLY TO THERMAL POWER PLANTS,

Sargent and Lundy, Chicago, Ill.
E. J. Stankiewicz.

Journal of Power Division, Proceedings of the ASCE, Paper 1889, p 1-23, Dec 1958. 14 fig.

Descriptors: *Cooling water, *Thermal power plant, Condensers, Cooling towers, Pipes.

Identifiers: Closed circulation system, Direct circulation system, Circulating water pumps, Spray ponds, Crib houses, Cooling ponds.

Water supply to thermal power plants is the chief factor in locating plant sites, because of cooling water requirements, and accounts for the largest single nationwide water use. Total thermoelectric capacity of the country for 1957 was 102 million kw, with a 0.59 capacity use factor, condenser cooling water amounts to 70 billion gallons per day, equivalent to 27% of our total national use of 261 billion gallons. Sources of circulating water supply maybe natural or man-made. Two basic types of circulating water systems are direct circulation and closed circulation. In the direct circulation system, water is pumped directly from source to condenser and is discharged downstream of the source. Over 70% by water use was direct circulation in 1957. Examples of each type of use are given. There is no reuse of water in direct circulation. Arrangement of circulating water systems depends primarily on the basic type of system, the total height through which the water must be lifted and whether the plant is a grade level or a basement type station. The extent of hydrographic and hydraulic studies in developing and delivering the water supply and with reference to main building substructure depends to a great extent on whether the station has a river or a lake source with direct circulation or any closed circulation system. The trend has been to use a pipe for the intake line, with the circulating water pumps in the crib house, as this combination tends to reduce costs in several ways. Illustrated examples of direct circulation river stations and closed circulation stations are given. (Upadhyaya-Vanderbilt)
W70-03548

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,

Worcester Polytechnic Inst., Mass.

For primary bibliographic entry see Field 05B.
W70-03549

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,

Puerto Rico Univ., Mayaguez. Dept. of Agricultural Economics.

Isidoro A. Cordero.

Available from the Clearinghouse as PB-189 157, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute Technical Completion Report, Puerto Rico University, Sept 1969. 213 p, 14 tab, 49 ref. OWRR Proj No A-010-PR.

Descriptors: *Water resources development, *Puerto Rico, *Water management (Applied), Groundwater, Surface waters, Irrigation water, Water supply, Sewage treatment, Water pollution control, Flood control, Land management, Water sources, Evapotranspiration, Water law, Water rights.
Identifiers: Water resources management.

The present status of water resources management in Puerto Rico is reviewed. Topics discussed include the island's hydrology, streamflow, water availability, water use, water rights, predictions of future needs, water problems, and recommendations. The major problems are pollution control, reservoir sedimentation, flood control, irrigation needs, drainage, and salt water intrusion. Puerto Rico is rapidly industrializing and must solve these problems to continue increasing the standard of living. (Knapp-USGS)
W70-03246

FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS

OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.

Corps of Engineers, Buffalo, N.Y.

Report prepared for Genesee River Basin Regional Water Resources Planning Board. Corps of Engineers Flood Plain Report, Sept 1969. 48 p, 12 fig, 13 plate, 14 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Monroe County (NY), Standard project flood, Intermediate regional flood.

Flooding of Black Creek and Genesee River in Chili and Riga, Monroe County, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03261

FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.

Corps of Engineers, Seattle, Wash.

Report prepared for Montana State Water Resources Board. Corps of Engineers Flood Plain Report, Sept 1969. 57 p, 11 fig, 15 plate, 15 tab.

Descriptors: *Floods, *Flood damage, *Montana, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.

Identifiers: Kalispell (Mont), Columbia Falls (Mont), Flathead River, Standard project flood, Intermediate regional flood.

Flooding of the Flathead, Stillwater, and Whitefish Rivers, Kalispell - Columbia Falls, Montana is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03272

FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.

Corps of Engineers, Jacksonville, Fla.

Report prepared for Board of Commissioners of Palm Beach County. Corps of Engineers Flood Plain Report, Nov 1969. 36 p, 22 fig, 15 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Florida, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Storms, Tidal effects, Coastal plains, Hurricanes, Rain, Winds.
Identifiers: Palm Beach County (Fla), Standard project flood, Intermediate regional flood.

Flooding of the tidal areas of Palm Beach County, Florida is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the

WATER QUANTITY MANAGEMENT AND CONTROL—Field 04

Control of Water on the Surface—Group 4A

construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03273

PENN CENTRAL CO V BUCKLEY AND CO, INC (RAILROAD DENIED INJUNCTIVE RELIEF).

415 F2d 762-764 (3d Cir 1969).

Descriptors: *Navigable waters, *Railroads, *Bridges, *Boats, Admiralty, Legal aspects, Rivers, New Jersey, New York, Navigable rivers, Navigation, Transportation, Damages, Remedies, Judicial decisions.

Identifiers: Injunctions (Prohibitory).

The plaintiff, a railroad that owned and operated a draw bridge, was denied an injunction restraining certain tug boat operations. The court of appeals found that plaintiff had failed to show that monetary compensation would not provide adequate relief in the event of injury to the bridge or delays in rail traffic. The court considered navigation as the paramount use of the waterways; it treated bridge piers as tolerated obstructions. (Casey-Florida)
W70-03298

PIRMAN V FLORIDA STATE IMPROVEMENT COMM'N, AND STATE RD. DEPT' OF FLORIDA (BRIDGE CONSTRUCTION).

78 So2d 718-722 (Fla 1955).

Descriptors: *Bridge construction, *Florida, *Judicial decisions, *Riparian rights, Remedies, Riparian land, Bridges, Property values, State governments, Administrative agencies, Decision making, Economics, Project planning, Construction costs.

Certain property owners attacked the determination by an administrative agency of the location of a bridge to be constructed through a bay in connection with a road. They attempted to forestall construction of the bridge and brought suit contending that: (1) the legal description of the Palma Sola Bay Bridge was so indefinite that the actual location could not be determined and the determination of a lawfully constituted administrative authority was therefore arbitrary and capricious; (2) running the roadway through Palma Sola Bay violated the property rights of appellants owning riparian property on the Bay, north of the crossing. The supreme court, in affirming the lower court, held that there was no constitutional authority to the effect that the location of the bridge should be fixed with such certainty that it could be located by a surveyor, a prerequisite to issuance or validation of bonds. Nothing was evidenced to show that action by the board of county commissioners or any other lawfully constituted board was arbitrary and capricious. Therefore, the supreme court would not substitute its judgement for that of the boards in question. The riparian owners on the north shore of the Bay, who did not hold any property to be acquired in the building of the bridge were without right to compensation for violation of property rights. (Moulder-Florida)
W70-03300

LEVEE DISTRICTS.

Miss Const art 11, secs 227 thru 239 (1890).

Descriptors: *Mississippi, *Levees, *Water districts, *Administrative agencies, Boundaries (Property), Taxes, Tax rate, Assessments, Legislation, Mississippi River, Maintenance, Right-of-way, Construction, State governments, Legal aspects, Water policy, Zoning, Repairing, Administration, Management, Federal government, Supervisory control (Power).

Identifiers: *Alluvial land, Levee districts.

The Yazoo-Mississippi Delta Levee District and the Mississippi Levee District encompass and divide the alluvial land of the state for levee system pur-

poses. Each district has a board of levee commissioners, and provision for their membership, qualifications, election, and bonding is detailed. Such commissioners shall have the power: (1) to supervise the erection, repair, and maintenance of levees in their respective districts; (2) to cede their rights of way and levees to the United States; and (3) to appropriate private property. No bills changing the boundaries of the district, or affecting the taxation or revenue of the district may be considered without proper publication. Each levee board makes an annual report to the Governor. The legislature shall: (1) levy a uniform tax upon lands in each levee district; (2) authorize the levee boards to fix the annual rate of taxation; (3) have the full power to provide a system of taxation for said levee districts; and (4) require the levee boards to publish an itemized account of their receipts and appropriations. No property between the levee and the Mississippi River shall be taxed for levee purposes. (Schram-Florida)
W70-03302

WALLACE V SCHNEIDER (SURFACE DRAINAGE).

219 SW2d 977-982 (Ky Ct App 1949).

Descriptors: *Kentucky, *Drainage water, *Diverion, Judicial decisions, Drainage systems, Surface runoff, Drainage, Drains, Channels, Culverts, Ditches, Sewers, Surface drainage, Riddance (Legal aspects), Surface waters, Drainage effects, Damages, Alteration of flow, Legal aspects.

Identifiers: Injunctions (Prohibitory).

An adjoining landowner constructed a system of drains, culverts, ditches, and gutters. Appellants alleged that this construction caused water to be discharged in unnatural quantities and at unnatural places on their land and to their damage. The lower court refused to grant an injunction to enjoin appellees from maintaining the aforementioned ditches, culverts, and drains. An appeal was taken. The lower court's decision was affirmed. The court held that the owner of the dominant estate may drain and ditch his land to rid it of surface water by construction of sewers, drains, and culverts without liability to the owner of the servient estate for damage, even though the flow of surface water onto the servient estate is thereby accelerated, so long as he does not: (1) tap additional watersheds or; (2) divert surface water from natural drains in which ditches, gutters, sewers, or culverts are constructed. The evidence presented sustained a finding that provisions (1) and (2) had not been violated. (Moulder-Florida)
W70-03321

PATY V TOWN OF PALM BEACH (GROIN-ORIGINATING LAND DAMAGE).

29 So2d 363-364 (Fla 1947).

Descriptors: *Florida, *Judicial decisions, *Breakwaters, Sea walls, Check structures, Jetties, Ocean waves, Shore protection, Barriers, Retaining walls, Coastal structures, State jurisdiction, Scour, Washouts, Wave pile-up, Damages, Cities.

The city of West Palm Beach had been authorized to construct seawalls, bulkheads, and groins to protect against destruction by the ocean. The implementation of the foregoing authorization resulted in the alleged damage of plaintiff's land. Damage, to be actionable, must be coupled with negligence or misconduct. No action for damages arises from conduct of people in the execution of a public trust for the public benefit when such conduct reflects due skill and caution and is within the scope of authority. Here, the city was being sued for the alleged damages resulting from an authorized act. The resulting damage was damage without injury, hence the land owners could not recover from city. (Moulder-Florida)
W70-03330

NAVIGABLE WATERS.
Miss Code Ann sec 686 (1956).

Descriptors: *Mississippi, *Navigable waters, *Navigable rivers, *Bayous, Streams, Legislation, Rivers, Width, Dimensions, Depth, Distance, Length.

All rivers, creeks and bayous, twenty-five miles in length and having sufficient depth and width of water for thirty consecutive days in the year to float a steamboat with a capacity of two hundred bales of cotton, are navigable waters and public highways. (Schram-Florida)
W70-03337

LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,

Lincoln City-Lancaster County Planning Commission, Nebr.

For primary bibliographic entry see Field 06F.
W70-03341

THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,

Commissioner of Parks and Public Property, Cedar Rapids, Iowa.

For primary bibliographic entry see Field 06F.
W70-03342

DRAINAGE.

III Ann Stat ch 42, secs 10-1 thru 10-11 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Administration, *Water management (Applied), *Drainage districts, Legislation, Regulation, Drainage, State governments, Drainage systems, Drains, Levees, Administrative agencies, Economics, Legal aspects, Local governments.

When a petition praying for the abandonment of construction in a drainage district is filed with the court before a contract for such construction is entered, the court shall order the district commissioners to abandon such work. Similar procedures are available to cause abandonment of a portion of the proposed work. The procedure for abandonment in districts, subdistricts, and minor subdistricts is the same. The court may, upon petition by land owners, dissolve a drainage district. Provisions for such dissolution are set forth. If an order is entered by the court dissolving a district, the commissioners of the district become trustees vested with title to all real and personal property of the district. This property may be sold. Subdistricts and minor subdistricts, upon petition of land owners, may be dissolved in the same manner as provided for main districts. Whenever a district, subdistrict, or minor subdistrict has been dissolved, all drains and levees are deemed to be for the mutual benefit of the lands formerly in the district. (Moulder-Florida)
W70-03347

TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA,

Agricultural Research Service, Brawley, Calif.

Luther B. Grass.
J Soil Water Conserv, Vol 24, No 4, p 135-138, July-Aug 1969. 4 p, 7 fig, 2 tab, 19 ref.

Descriptors: *Drain tiles, *Tile drains, *Iron oxides, Manganese compounds, Drainage, Drainage engineering, Drainage systems, Tiles, Tile drainage, Drains, Deposition, Chemical precipitation, Soil types, Operation and maintenance, Irrigation operation and maintenance, Bibliographies, Iron bacteria.

Identifiers: *Clogging, Imperial Valley (Calif), Imperial Irrigation District (Calif).

Tile drains are used extensively in the Imperial Valley of California to control water tables and prevent salt accumulation in soils. By 1955, water tables had developed over some tile lines, reducing

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

crop growth either by restricting root growth or by increasing salinity. When opened for inspection, the lines were found clogged by black and red deposits composed of manganese and iron oxides. Theories proposed to explain the deposits are: (1) the problem predominates near faults, (2) the problem is peculiar to certain soil textures, and (3) the type of tile used contributes to the problem. A survey was made of tile lines in the Imperial Valley. The severity of clogging varied widely and the deposits were observed in various physical forms. The survey indicated that formation of red or black deposits was not related to location, soil type, kind of tile material, or length of time the drains had been in service. Tile systems clogged with iron and manganese deposits can be reclaimed effectively by treatment with sulfur dioxide gas and water. (USBR)

W70-03357

PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS,
For primary bibliographic entry see Field 06E.
W70-03380

ARE WE LOSING OUR LAKES,
For primary bibliographic entry see Field 06E.
W70-03382

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA,
For primary bibliographic entry see Field 06E.
W70-03386

CONSERVANCY DISTRICTS (WATERCOURSES, WATER RIGHTS AND USES, AND CONSTRUCTION AND MAINTENANCE OF RECREATIONAL FACILITIES).

Ohio Rev Code Ann secs 6101.20 thru 6101.25 (Page 1953), as amended, (Supp 1970), sec 6101.241 (Supp 1970).

Descriptors: *Ohio, *Administrative agencies, *Water utilization, *Water conservation, Bridges, Structures, Aqueducts, Streams, Sewers, Pipelines, Streamflow, Rainfall, Excavation, Channels, Flood control, Domestic water, Federal government, Drainage, Recreation, Soil erosion, Parks, Water supply, Riparian rights, Industrial water, Irrigation, Fisheries.

The court may order owners of bridges or structures over watercourses to remove or modify such structures pursuant to a district plan. If such changes are not made, the Board of Directors of Conservancy Districts can make them. The Directors have the power to improve watercourses. Private owners shall bear the cost of improvements required because of interference with water flow. Owners of bridges or grades shall provide access for dredge boats or other equipment. The Directors may make surveys and investigations of rainfall and stream flow and may provide for flood warning services. The Directors may enter into contracts with the United States Government or other public or private agencies for the development and maintenance of waters, parks, and recreational facilities. The rights of water users to the waters of the District shall remain the same, but the District will become the owner of improvements which it constructs. If the District is a riparian owner it has riparian rights. The District shall be compensated for the use of its waters. The Directors may construct and maintain recreational facilities. (Duss-Florida)

W70-03395

COUNTY WATER SUPPLY SYSTEMS.
Ohio Rev Code Ann secs 6103.01-6103.05 (Page 1953), as amended, (Supp 1970), secs 6103.051, 6103.052 (Supp 1970).

Descriptors: *Ohio, *Water supply, *Permits, *Administrative agencies, Legislation, State governments, Local governments, Water works, Water distribution (Applied), Equipment, Financing, Water conveyance, Sanitary engineering, Sewers, Water sources, Consumptive use, Water utilization, Legal aspects.

Public water supply is defined as wells, streams, and other sources, and the equipment necessary for the distribution of the water supply. The board of county commissioners of any county may acquire and operate any water supply within its boundaries. The board shall issue and enforce rules and rates regarding such supply. Permission for any construction regarding the supply must first be granted by the board. The board's authority for the supply located within a municipal corporation shall extend to main works only. The municipal corporation's legislative body may expand the board's authority. The board will retain jurisdiction over sewer districts annexed to a municipal corporation for water works purposes until all plans or improvements in progress are completed or abandoned. The county sanitary engineer shall submit a general plan for water supply to the board for approval. All assessments for water supplied may be deferred for good cause by the board. An advance of money from the water and sewer rotary fund can be made to cover the amounts not collected because of deferred assessments; advances by the fund are limited to the cost of authorized improvements. Repayment procedures are outlined. (Barnett-Florida)

W70-03396

WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS).
For primary bibliographic entry see Field 03D.
W70-03397

WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS).

Ohio Rev Code Ann secs 6131.01 thru 6131.13 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Water conservation, *Water management (Applied), *Water resources development, Legislation, Legal aspects, Benefits, Ditches, Drains, Watercourses (Legal), Rivers, Levees, Embankments, Dams, Reservoirs, Streams, Lakes, Bridges, Flood control, Water utilization, Administrative agencies, Construction, Water resources, Surplus water, Financing, Estimated costs, Water policy, Regulation, Federal government, Cost-benefit theory.

Identifiers: *Improvements.

Improvement means the construction or beneficial alteration of any ditch, drain, watercourse, levee, wall, embankment, dam, or reservoir. Benefits means advantages resulting from drainage, conservation, control, and management of water. Benefits include the following: (1) elimination or reduction of flood damage; (2) removal of water conditions that jeopardize public health, safety or welfare; (3) resulting increased land values; (4) use of water for irrigation, storage, regulation of stream flow, soil conservation or water supply; and (5) providing an outlet for accelerated upland runoff. Boards of county commissioners may authorize improvements if they find that the improvement will be conducive to the public welfare and that the cost of the improvement will be less than the benefits conferred by its construction. Landowners and government agencies may petition boards to authorize improvements. The procedure to be followed in filing and amending petitions, posting bond for the cost of determining feasibility of the proposed improvement, viewing the site of the proposed improvement, preparation of preliminary cost estimates and conducting a hearing on the proposed improvement is in each case set forth. Boards may construct a complete or coordinating system of water conservation and flood control. (Keith-Florida)

W70-03401

WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS).

Ohio Rev Code Ann secs 6131.14, 6131.47, 6131.59, 6131.63, 6131.64 (Page 1953), as amended, (Supp 1970), 6131.631 (Supp 1970).

Descriptors: *Ohio, *Surface drainage, *Ditches, *Drains, Legislation, Legal aspects, Administrative agencies, Surveys, Planning, Structures, Estimates costs, Construction, Assessments, Boundaries (Property), Drainage, Natural resources, Easements, Culverts, Bridges, Contracts, Floodgates, Watercourses (Legal), Damages, Channels, Maintenance, Highways, Public utilities, Drainage engineering.

Identifiers: *Improvements.

The board of county commissioners will send a copy of its findings in favor of drainage improvements to the county engineer. The engineer will make a survey of and plans for the proposed improvement. The engineer will send such plans, along with cost estimates, to named administrative agencies for their approval. Upon receipt of approval, the engineer will forward the approved plans and cost estimates to the board. The engineer may direct the owner of any culvert, bridge, fence or floodgate to remove or alter the same when necessary for the construction of an improvement. The owner will be compensated for damages. When an improvement consisting of a ditch, drain or watercourse has been used as the outlet of agricultural drainage for seven years or more, it will be deemed to be a public watercourse. The public will have the same rights therein as it would in a natural watercourse. Owners of adjacent lands may agree to construct a mutually beneficial ditch or drain. When such agreement is filed with the county auditor, the ditch or drain is established as a public watercourse. If the board declares an improvement vacated, private rights in the improvement will not be affected. (Keith-Florida)

W70-03402

WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES).

Ohio Rev Code Ann secs 6135.01 thru 6135.27 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ditches, *Interstate, *Ohio, *Drainage systems, Cooperatives, Drains, Drainage, Conduits, Distribution systems, Diversions structures, Drainage engineering, Statutes, Legislation, Local governments, Cost analysis, Costs, Projects, Project benefits, Engineers estimates, Project feasibility, Cost allocation, Outlets. Identifiers: *Interstate county ditches.

A joint board to supervise interstate county ditch projects shall be composed of the boards of county commissions of counties affected in Ohio and those boards affected in adjoining states. The procedure, powers, and duties of the joint board at the organizational meeting are established. The duties of the engineer appointed by the joint board are enumerated. Specific regulations set forth the rules governing subsequent joint board meetings. The power to enter upon lands in Ohio in connection with interstate county ditch projects is delegated to the proper authorities in the adjoining state. Project costs are apportioned and lands not mentioned in the first engineer report may be assessed. Ohio boards of county commissioners are permitted to conduct work beyond the state limits if authorized by the adjoining state. Procedures concerning claims for compensation and damages are provided. Water outlet projects located in either Ohio or an adjoining state are regulated. The methods of financing or assessing the costs of such projects are prescribed. The boards of county commissioners in Ohio must record in their journals the details of all interstate county ditch agreements. Absent specific interstate county ditch provisions, the laws governing Ohio county ditches control. (Powell-Florida)

W70-03403

Control of Water on the Surface—Group 4A

WATER SUPPLY--SANITATION--DITCHES.

Ohio Rev Code Ann secs 6139.01 thru 6139.06
(Page 1953).

Descriptors: *Ohio, *Ditches, *Drains, *Drainage systems, Subsurface drains, Drainage, Conduits, Distribution, Systems, Diversion structures, Drainage engineering, Controlled drainage, Subsurface drainage, Surface drainage, Legislation, Local governments, Cost analysis, Projects, Project benefits, Cost allocation, Outlets.
Identifiers: *Township ditches.

A petition to improve a ditch or drain located within a township and having an outlet in a public watercourse may be filed with the clerk of such township. The work and material for construction of an improvement are apportioned among the landowners according to the benefits received. If the owner does not construct his portion of the improvement, the cost of such township ditch improvement will be assessed to the landowner. The rights and remedies afforded to a landowner affected by an improvement are provided in sections 6131.01 to 6131.64, inclusive of the Revised Code. The jurisdiction of the boards of county commissioners and boards of township trustees in regard to location of ditches is provided. The procedures to be followed for locating underground drains on land adjoining upland owners and for compensating the lower landowner are regulated. (Powell-Florida)
W70-03404

CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS).

Ohio Rev Code Ann secs 1523.01 thru 1523.20
(Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Flood control, *Water conservation, *Navigation, Legislation, Dams, Legal aspects, Canals, Administrative agencies, Surplus water, Public health, Safety, Reservoirs, Dikes, Planning, Financing, Contract administration, Contracts, Hydroelectric power, Jurisdiction, Bridges, Culverts, Surveys, Construction, Maintenance, Riparian rights, Water supply, Estimated costs.
Identifiers: *Water improvements, Storage basins, Emergencies, Slack-water dams.

The Chief of the Division of Water is authorized to construct such reservoirs, dams, storage basins, dikes, canals, raceways and other improvements as are necessary for the following purposes: (1) to insure and promote the public health, welfare and safety; (2) to encourage and promote agriculture, commerce, manufacturing and other public purposes; and (3) to preserve the use of waters required for navigation. The Chief may also make additions to, enlarge, and alter existing improvements for such purposes. Before the Chief begins any such construction, he will submit plans and cost estimates of the proposed improvement to the Governor for approval. The procedure to be followed by the Chief in issuing bonds to finance improvements is delineated. The procedure to be followed by the Chief in the letting and administering of contracts for the construction or maintenance of improvements is set forth. The Chief may sell or lease water and power from future and existing improvements unless to do so would be detrimental to canal navigation. Bonds issued on improvements constitute a lien which may be foreclosed. No reduction in the quantity or quality of the water supply of any city is authorized by this chapter. (Keith-Florida)
W70-03406

STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT.
For primary bibliographic entry see Field 06E.
W70-03410**COMPACT CONCERNING PYMATUNING LAKE.**

For primary bibliographic entry see Field 06E.
W70-03411

WATERS, WATERWAYS, DRAINS AND LEVEES (WATERCOURSES).

Tenn Code Ann secs 70-101 thru 70-121 (1956).

Descriptors: *Tennessee, *Navigable waters, *Water resources development, *Navigation, Navigable rivers, Riparian rights, Riparian waters, Ships, Boats, Transportation, Sluices, Sluice gates, Regulation, Channels, Diversion structures, Highways, Administration, Administrative agencies, Railroads, Bridges, Fish, Fish barriers, Fish migration, Stream improvement, Mill dams, Mills, Legislation, Legal aspects.

All navigable waters are public highways. The quarterly county court may contract to open or clean out any navigable stream within the county. Overseers may be appointed for such navigable stream districts as the county may lay off, and regulations therein shall be the same as in the case of public roads. Court appointed supervisors of water improvements shall investigate and prosecute all offenses committed in regard to streams. It is unlawful to divert water from or to obstruct the navigation of the main or natural channel of any navigable watercourse. The water of any sluice may be diverted into a main channel for the immediate passage of a boat but must be returned so as not to impair the profit of the mill. The county court may permit and/or remove local improvements and erections in watercourses provided navigation is not interrupted. The court may appoint commissioners to see that local erections conform to law and allow the free passage of fish. Railroad companies shall operate drawbridges according to set standards. All eleemosynary institutions shall have the right to obtain property for the purpose of procuring water. (Smith-Florida)
W70-03413

LEVEE AND DRAINAGE DISTRICTS.

Tenn Code Ann secs 70-901 thru 70-914 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Drainage districts, *Financing, *Assessments, Levees, Flood control, Flood protection, Legislation, Administrative agencies, Construction, Construction costs, Drainage engineering, Drainage programs, Drainage systems, Taxes, Payment, Tax rate, Costs, Cost-benefit ratio, Cost-benefit theory, Benefits, Evaluation.

When a levee or drainage district is established, the county court shall appoint three uninterested commissioners from the county, one of whom shall be an engineer. The commissioners shall assess all lands benefited by the levee or drainage district by the amount of benefit and equitably apportion the expenses, construction costs, and damages for such improvement. All of the above information, as well as the description and ownership of the land, shall be reported to the county court. Any railroad or public highway will be assessed for any benefit received from the levee or drainage district's improvements. (Schram-Florida)
W70-03436

ESTABLISHMENT OF DRAINAGE DISTRICTS BY MUTUAL CONSENT.

Tenn Code Ann secs 70-1701 thru 70-1703 (1956).

Descriptors: *Tennessee, *Drainage districts, *Ditches, *Drains, Legislation, Jurisdiction, Drainage systems, Construction, Locating, Sites, Damages, Assessments, Benefits, Judicial decisions, Watercourses (Legal), Drainage programs.

The owners of land which require combined drainage may provide for the establishment of a

drainage district or the location and construction of drains, ditches, and watercourses upon their own lands. Such an agreement may specify the location, the character of work to be done, the adjustment of damages, the classification of lands to be benefited, the amount of special assessments, and the time for levying assessments. Upon filing the agreement with the clerk of the county court, the court shall establish such drainage district and locate the ditch, drain, or watercourse as provided in the agreement. The court shall have complete jurisdiction over the parties and the subject matter. (Schram-Florida)
W70-03419

TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.

For primary bibliographic entry see Field 06B.
W70-03422

WATER RESERVOIR SYSTEMS.

Autonetics Division of North American Rockwell Corporation, Anaheim, California, Life Sciences Operations.

Available from the Clearinghouse, Vol 1, PB-189 340, Vol 2 as PB-189 341, \$3.00 each in paper copy, \$0.65 each in microfiche. Final Report of North American Rockwell Corporation to Office of Water Resources Research, Department of Interior, 2 Vol: Vol 2, Nov 1, 1968. 184 p, 53 fig, 35 tab, 26 ref, 1 append Vol 2, Dec 22, 1969. 73 p, 17 fig, 13 tab, 24 ref. OWRR No C-1187 (1595).

Descriptors: *Flood control, *Cities, *Urbanization, *Reservoirs, Costs, Cost-benefit analysis, Drainage systems, Economics, Social aspects, Dams, Multiple-purpose projects.
Identifiers: *Urban flood-control reservoirs.

Water reservoir systems were investigated for urban areas as an alternative or complement to storm water drainage systems for flood control which could provide benefits in water conservation and reduce drainage system costs. Santa Maria, California, was selected as a study site. Santa Maria has characteristics of seasonal rainfall that cause urban flooding, a need for water conservation (dropping water table), and high underground water percolation rates that favor a reservoir system. The study included a total of 8,000 acres of which 2,500 acres are highly urbanized, 3,800 acres represent future urban development and 1,700 acres are projected as agricultural through the year 2000. The Stanford Watershed Model was used for a computer simulation of the Santa Maria watershed and design of the reservoir system. The reservoir system cost for the total Santa Maria area of 8,000 acres is \$7.0 million, a significant decrease in cost over the conventional system even with the addition of land costs. Water conservation and multiple land use benefits provide distinct economic advantages in favor of the reservoir system that can defray up to 50% of the system costs. (Knapp-USGS)
W70-03435

GRACI V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR NEGLIGENCE IN CONSTRUCTION OF NAVIGATION AID PROJECT).

301 F Supp 947-956 (ED La 1969).

Descriptors: *United States, *Flood control, *Flood damage, Judicial decisions, Legal aspects, Mississippi River, Rivers, Louisiana, Navigation, Navigable waters, Floods, Projects, Bodies of water, Damages, Flood protection, Jurisdiction, Water injuries, Remedies.
Identifiers: Flood Control Act, Federal Tort Claims Act.

The defendant United States moved for dismissal of a tort claim by plaintiff homeowners for flood water damage allegedly caused by defendant's

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

negligence in the construction of navigation aid projects. The court rejected the government's contention that the actions were not maintainable by virtue of the immunity clause contained within the Flood Control Act, and held that the federal government could be held liable if negligence was proven. The court relied upon the Federal Tort Claims Act's more reasonable, liberal, and equitable policy of a general waiver of immunity in the particular circumstances of this action notwithstanding the Flood Control Act, which eliminates federal liability for flood damages. The court permitted plaintiffs to litigate their claim for damages, but placed them under a burden of proof greater than in a normal tort case. (Casey-Florida)

W70-03444

STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,

Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.

W70-03497

RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT,

Toronto Univ. (Ontario). Dept. of Mechanical Engineering.

Vit Klemes.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 54, p 414-421, 1967. 8 p, 1 fig, 4 ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Reservoir yield, *Probability, *Statistical methods, Safe yield, Runoff forecasting, Water storage.

Identifiers: Reservoir content probability.

Reliability of storage-reservoir operation may be judged from three different points of view. One may consider the number of failures in water supply within a given period, or the total duration of failures, or the deficit of water not supplied to the consumer. According to the criterion adopted, three different characteristics of reliability can be used, in particular, the occurrence-, time-, and quantity-based 'certainty'. While certainty is represented by a single value if an unlimited period of time is considered, it has a distribution in case of finite period. A method is presented for determining the distribution of certainty of any of the three above mentioned types, for a reservoir with seasonal input. The method employs Moran's discrete approximation to a continuous distribution, and Gould's method for determination of the transition probabilities. (Knapp-USGS)

W70-03498

STATE WATER POLICY COMMISSION - POWERS AND DUTIES.

N J Stat Ann secs 58: 1-9 to 58: 1-13, 58: 1-15 to 58: 1-18, 58: 1-24 (1966).

Descriptors: *New Jersey, *Administrative agencies, *Water resources development, *Legislation, Legal aspects, Water supply, Diversion, Condemnation, Project planning, Water sources, Investigations, Dams, Irrigation, Watershed management.

Identifiers: Reports.

The State Water Policy Commission shall have all the powers and duties formerly vested in the Department of Conservation relating to water supply matters, control of dams, flood control, irrigation and water power. The commission shall supervise all public water supplies. The Commission shall complete a study of the water resources of the entire state to allow it to perform its assigned duties. The findings of such study shall be reported to the legislature to the end that a final plan will be formulated for the economical and comprehensive development of the watersheds of this state. Plans

for watershed development must provide sufficient details of the developments to be made to allow coordination of such plans. The Commission may require annual reports relative to water diverted for water supply purposes. A quarterly report of the amount of water used by waterworks is also required. The Commission must approve any condemnation of new or additional sources of water supply for projects to supply inhabitants with water. Plans for such projects must be submitted to the Commission for approval. Before such Commission approved water supply systems can begin operation, the work itself must be approved by the Commission. (Sisserson-Florida)

W70-03499

STATE WATER POLICY COMMISSION - POWERS AND DUTIES.

NJ Stat Ann secs 58:1-25, 58:1-26, 58:1-31, 58:1-33, 58:1-35, thru 58:1-38, 58:1-45 (1966).

Descriptors: *New Jersey, *Administrative agencies, *Water supply, *Water resources development, Legal aspects, Watershed management, State governments, Legislation, Diversion, Investigations, Dams, Permits, Consumptive use, Streams, Construction, Impounded waters, Channel flow, Public rights, Diversion structures.

The state Water Policy Commission may order the interconnecting of public water supply systems and require the furnishing of water by means of any such system to another. The Commission shall regulate the construction, maintenance, and removal of structures within streams to preserve the channels of streams and to safeguard the public against danger from waters impounded by such structures. The Commission may enter on any land or water for any investigation authorized by this chapter. This chapter does not limit the powers of existing water works systems to develop their present system. However, approval must be obtained from the Commission for constructing or enlarging dams. The definitional section defines such terms as consumptive use, surface waters and low flow. The Water Policy and Supply Council in the Department of Conservation shall delineate those watershed areas in need of regulation. In such areas a permit shall be required to divert water for other than domestic use at a rate greater than 70 gallons per minute. Such permit shall be issued without a public hearing when satisfactory evidence is provided that the water diverted is not to be consumptively used. Nothing in this chapter shall affect the storage and regulation of the discharge of stored waters to supplement streams. (Sisserson-Florida)

W70-03514

VACATION OR RELOCATION OF WATER COURSES - CONSTRUCTION OF DAMS.

Pa Stat Ann tit 53, secs 2801-2802, 2815, 2831 (1957).

Descriptors: *Pennsylvania, *Dams, *Channel improvement, *Cities, Channels, Relocation, Legislation, Condemnation, Eminent domain, Watercourses (Legal), Navigable streams, Public health, Local governments, Alteration of flow, Water works, Water supply, Dam construction, Sanitary engineering, Compensation, Condemnation value, Stream improvement, Domestic water, Channeling, Legal aspects.

Any city may by ordinance vacate, alter, or relocate the course or channel of any creek, run or natural waterway, other than navigable streams, when it deems it essential to the preservation of the health and welfare of its inhabitants. The city may enter upon, condemn, and take any property within the city's limits as may be necessary to effect such change. If any such creek, run, or natural waterway is used by any municipality or water company as a source of supply of water, the municipality or water company must first consent to the proposed relocation. Whenever the state allows a city to construct and maintain a dam in a public navigable river

flowing through the city to improve the sanitary conditions of the city, power is also granted to purchase, acquire, and appropriate private property for that purpose. If the city cannot agree with the owners of the private property upon the compensation for the appropriated property, any interested party may petition the county court to appoint viewers to ascertain the damages done by such taking. (Schram-Florida)

W70-03521

FLOOD CONTROL.

Pa Stat Ann tit 53, secs 2866 (1957), 2862 (Supp 1969).

Descriptors: *Pennsylvania, *Flood control, *Flood protection, *Assessments, Cities, Legislation, Channel improvement, Dikes, Flood damage, Floods, Streams, Local governments, Construction, Banks, Channels, Bank protection, Stream improvement, Rivers, Public benefits, Floodwater, Taxes, Costs, Cost allocation, Cost-benefit analysis, Benefits, Financing, Legal aspects.

Any municipality may erect or construct dikes, river bank protection, and other flood control works and widen, deepen, straighten or otherwise improve the channels and banks of creeks, streams, and rivers. These improvements may be made either within or without the county in which the municipality is situated. Any two or more municipalities may jointly construct these improvements and may enter into agreements with other public authorities as may be necessary for such purposes. Any municipality may provide for the assessment of benefits against private property located within its corporate limits. No assessment shall be made against private property unless, in the opinion of the board of viewers making the assessment, the property will be benefited by the prevention or lessening of future flood damage. The fact that private property has been damaged by flood from the waters of the stream on which the work is being done shall be conclusive evidence that benefit will accrue to such property. No exemption shall exist because the property does not abut on any improvement or on the stream carrying the flood waters. (Schram-Florida)

W70-03529

BRIDGES AND VIADUCTS.

Pa Stat Ann tit 53, secs 2501, 2504, 2551, 2581, 2611, 2619, 2628 (1957).

Descriptors: *Pennsylvania, *Bridges, *Bridge construction, *Cities, Legislation, Local governments, Structures, Abutments, Piers, Railroads, Rivers, Streams, Highways, Construction, Maintenance, Landfills, Slopes, Condemnation, Costs, Erection, Transportation.

The cities of the Commonwealth may locate and build viaducts or bridges over rivers, streams, railroads, and private property for the purpose of uniting two or more highways. These constructions may be partially within and partially outside of the city limits. The cities may contract with the proper county commissioners, railroad interests, or any other interested parties for the construction, maintenance, or damages, caused by such bridges or viaducts. The cities may enter upon, take, and use private property to construct bridges over streams which separate any portions of such cities. Any city may also acquire any existing bridges that cross streams which divide the city. The municipalities of the state may purchase, condemn, or maintain any public toll bridge crossing any river or stream within the limits of such municipalities. Said cities may contract with county commissioners for the county to pay a portion of the costs of the toll bridges. It is unlawful to erect any free bridges over the Juanita River within one mile of any toll bridge constructed by a Pennsylvania corporation. If a county, however, wishes to purchase a toll bridge to make it a free bridge, it may do so under certain provisions. (Schram-Florida)

W70-03533

Control of Water on the Surface—Group 4A

OBSTRUCTIONS — IN NON-NAVIGABLE WATERS.
Wis Stat Ann sec 60.68 (1957).

Descriptors: *Wisconsin, *Non-navigable waters, *Obstruction to flow, *Streams, Creeks, Legislation, Cities, Navigable waters, Natural flow doctrine, Barriers, Navigation, Riparian rights, Streamflow, Flow, Legal aspects.

Whenever any non-navigable stream becomes obstructed so that the natural flow of water is prevented, the supervisors of the town in which the obstruction is located may, at the expense of the town, remove the obstruction. The supervisors are authorized to enter upon any lands necessary to carry out such purpose. (Casey-Florida)
W70-03536

HIGHWAY TO ISLANDS IN MISSISSIPPI RIVER.
Wis Stat Ann sec 80.15 (1957).

Descriptors: *Wisconsin, *Mississippi River, *Islands, *Road construction, Legislation, Administrative agencies, Access routes, Transportation, Eminent domain, Condemnation, Easements, Right-of-way, Navigable waters, Legal aspects.

An owner of an island in the bottoms of the Mississippi River who is shut out from the bank of the Mississippi River and from a highway by other islands, sloughs, or the lands of others through which rights-of-way cannot be purchased at a reasonable price may present to the supervisors of the town an affidavit which sets out these facts and describes the land. The supervisors shall, in their discretion, give relief under 80.13 of this act which provides for the construction of a highway when a real estate owner is shut out from all public highways. The town shall not be liable for want of repair or for defects in any highway laid out pursuant to this section, nor for any accident or injury thereon. (Barnett-Florida)
W70-03538

GRIMES V POLK COUNTY (PUBLIC RIGHTS IN PRIVATE DRAINAGE SYSTEMS).
34 NW 2d 767-773 (Iowa 1949).

Descriptors: *Iowa, *Road construction, *Drainage systems, *Surface runoff, Flood damage, Local governments, Drainage, Drainage engineering, Drainage water, Drainage effects, Outlets, Water control, Water sources, Judicial decisions, Building codes, Damages, Paving, Right-of-way, Highways, Prescriptive rights, Eminent domain, Surface drainage, Surface waters, Legal aspects, Surplus water.

Plaintiff's equitable complaint stated that in grading and paving a highway, defendant, Polk County, had caused an unlawful diversion of and interference with a natural water course which resulted in an excessive and unusual amount of water being cast upon her land. Plaintiff claimed defendant violated a statute requiring highways to be properly drained before paving is laid. Plaintiff's land was the servient estate in a common drainage project, and the water flowing thereon was from the dominant estate. A dominant estate has a right to discharge surface waters upon a servient estate. The court held that due to a lapse of over twenty years defendant has acquired prescriptive rights to the drainage project drains. Plaintiff knew of these drains when she purchased the land. Defendant has a statutory right to connect with the drainage project and to dispose of surface water on public highways, through private ditches and onto plaintiff's land. Where a former dirt highway is paved without a substantial change in grade, no drainage district must be created. The court held that casting such additional water on plaintiff's land was not a taking without compensation. (Smith-Florida)
W70-03562

OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION).
253 A2d 309-338 (Me 1969).

Descriptors: *Maine, *Water districts, *Sewage districts, *Public utilities, Judicial decisions, Legislation, Sewers, Governments, Sewage, Wastes, Sewage disposal, Sewage treatment, Flow, Water supply, Water, Rivers, Streams, Ponds, Dams, Reservoirs, Pumping plants, Eminent domain, Condemnation, Water storage.

The Senate of Maine requested the Justices of the Supreme Judicial Court to give opinions on the constitutionality of five bills pending in the Senate. The Court held that constitutional limitations on encroachment upon home rule rights of local governments did not invalidate the bills. The bills generally authorized certain water and sewer districts and companies to begin or expand water and sewer services. The Portland Water District is authorized to transmit, treat and dispose of waste water and sewage. The Harrison Water District is authorized to collect, store, and convey water from any body of water whether on the surface or underground. The Harrison District is also authorized to construct and maintain pipes, dams, wells, reservoirs, pumping stations and other structures necessary to furnish water for public purposes. For these purposes the District may acquire any land or water rights by gift, purchase or condemnation. The jurisdiction and borrowing power of other districts are extended. (Smith-Florida)
W70-03564

DRAINAGE DISTRICTS (ANNEXATION AND DETACHMENT OF LANDS).

III Ann Stat ch 42, secs 8-1 thru 8-22 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage systems, *Drainage districts, *Boundaries (Property), Legislation, Legal aspects, Drains, Ditches, Assessments, Judicial decisions, Cities, Levees, Storm drains, Outlets, Easements, Structures, Surface drainage, Multiple-purpose projects, Watersheds (Basins), Taxes, Financing, Cost allocation, Construction, Remedies.

Identifiers: Penalties (Civil).

Lands may be annexed to or detached from a drainage district. An owner of land lying outside a district but within the district's natural drainage area may connect his land to any ditch or drain of the district. By making such a connection, a landowner gives implied consent to the annexation of his land to the district. When land outside of a district has been connected to a district drain or when it will be benefited by any district work, the district commissioners may petition the court to annex such land to the district. Owners of land outside a district but within its drainage area may petition for annexation. Notice and hearing requirements concerning petitions are set forth. Land annexed to a district will be subject to assessments for improvements. Owners of land within a district may petition for detachment if their land is not and cannot presently be benefited by any work of the district. The court may detach land from one district and annex it to another. Land located within the boundaries of a drainage district and within the corporate limits of a city may be detached from the district, provided the city agrees to pay the district assessments for the continued drainage benefit to the land. (Keith-Florida)
W70-03565

DRAINAGE DISTRICTS.

Ark Stat Ann secs 21-501 thru 21-586 (1968).

Descriptors: *Arkansas, *Drainage districts, *Levees, *Administration, Benefits, Assessments, Taxes, Damages, Drains, Ditches, Financing, Condemnation, Federal government, Construction, Cost repayment, Administrative agencies, Legislation, Real property, Cost sharing, Maintenance,

Erosion, Cost allocation, Cost-benefit theory, Construction costs.

The procedures for establishing a drainage district in Arkansas are detailed. Provision is made for the appointment of a board of commissioners to control each district, and their powers and duties are outlined. A detailed procedure for assessing all property in the drainage districts according to the benefit theory is included. The manner of implementing drainage improvements is detailed with provision for extending the benefits and assessments beyond the drainage district. The procedure for taxing property within the drainage district is discussed and provision made for collection and repayment, and remedies for delinquency and default. Details of financing district improvements are included. A procedure for abolishing unnecessary or impractical districts is set forth. This act shall serve as an alternative means of creating a drainage district; the act does not repeal prior laws. Provisions for maintenance of the drainage district are discussed. A plan of cooperation with the federal government in constructing and maintaining drainage improvements is detailed. Provisions for subdistricts and districts created under special acts of the state legislature are outlined. Penalties are provided for violations of certain sections of this act. (Schram-Florida)
W70-03566

DRAINAGE DISTRICTS (ESTABLISHMENT).
Ark Stat Ann secs 21-501 thru 21-517 (1968).

Descriptors: *Arkansas, *Drainage districts, *Assessments, *Benefits, Legislation, Drainage systems, Drains, Ditches, Damages, Administration, Administrative agencies, Compensation, Condemnation, Right-of-way, Condemnation value, Taxes, Drainage effects, Cost-benefit theory, Drainage programs, Drainage practices, Construction.

Creation of a drainage district may be sought by petition to the county court. Provisions are included for bonding a survey of the proposed site, appointing an engineer, paying expenses, and conducting a public hearing. The appointment of district commissioners and the organization of a drainage board are discussed. The formation of subdistricts is permitted upon petition of three landowners. The appointment procedure for commissioners of subdistricts is set forth. The commissioners are authorized to assess the costs of improvements against all lands, public and corporate roads, and railroads benefited by the drainage system. The commissioners are directed to assess and award damages for injuries to land which arise from project construction. If lands outside the district are benefited, the county court may, after notice and a hearing, extend the boundaries of the district to include these lands. Upon completion and filing of all assessments by the commissioners, notice is to be given and complaints and appeals may be made by affected landowners. If a landowner so requests, damages to his land may be recovered through condemnation proceedings. Procedures for altering the plans for improvements and for reassessing necessary property are detailed. (Schram-Florida)
W70-03567

DRAINAGE DISTRICTS (CONSTRUCTING IMPROVEMENTS).
Ark Stat Ann secs 21-518 thru 21-541 (1968).

Descriptors: *Arkansas, *Drainage districts, *Assessments, *Financing, Drains, Ditches, Legislation, Administration, Administrative agencies, Benefits, Cost-benefit theory, Drainage systems, Drainage programs, Bridges, Construction, Taxes, Tax rate, Sewers, Condemnation, Condemnation value, Width, Depth, Length, Levees, Drainage practices.

Commissioners may extend and improve the drains in their district and may issue bonds to finance

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

these improvements. Commissioners may make annual reassessments of benefits, provided adequate notice is given to affected landowners. Before assessments for further improvements may be confirmed, a majority of the landowners in the district must petition for the construction of those improvements. The procedures for filing petitions and provisions for notice, hearing, and appeal are detailed. The Commissioners will control the construction of these improvements. Provisions are made for taking bids, soliciting contractor's bonds, and purchasing materials. Landowners may build ditches to drain water from their lands into the public ditches. The ditches may cross the lands of intervening landowners. The district is directed to build bridges over its ditches where they intersect county highways. The Commissioners may regulate the manner of building bridges and fences across any ditch to prevent injury to the drainage system. The Commissioners may construct ditches beyond the district when necessary and may acquire rights-of-way necessary to this construction. The Commissioners may levy additional taxes, with court approval, to maintain the district's improvements. Provisions are made for assessing annexed lands, reassessments, and additional assessments for increased benefits. The district may be extended to include lands served by sanitary sewers connected to drainage ditches. (Schram-Florida)
W70-03568

DRAINAGE DISTRICTS (TAXATION).

Ark Stat Ann secs 21-542 thru 21-550 (1968).

Descriptors: *Arkansas, *Drainage districts, *Taxes, *Tax rate, Financing, Legislation, Cost-benefit theory, Cost-benefit ratio, Administration, Administrative agencies, Assessments, Payment, Construction, Evaluation, Real property, Administrative decisions, Cost repayment, Bids, Interest.

The county court may order a tax levied upon the drainage district to pay improvement costs. A tax so imposed is a lien on all real property in the district, and is assessed proportionately for benefits derived from the district. Procedures for appeal from assessments and for compelling the court to comply with this section are outlined. Provisions are set forth for collection of drainage district taxes. A time limit is set for the payment of taxes and remedies are provided against delinquent taxpayers. Procedures are outlined for the sale of property subject to the drainage district's lien. (Schram-Florida)
W70-03569

CONTROL AND IMPROVEMENT OF NATURAL WATERCOURSES.

Ohio Rev Code Ann sec 755.28 (Page 1953).

Descriptors: *Ohio, *Watercourses (Legal), *Administration, *Eminent domain, Legislation, Local governments, Cities, Sewers, Maintenance, Construction, Management, Natural streams, Developed waters, Water Control, Water rights, Easements, Condemnation, Land, Cleaning, Water circulation, Water conveyance, Administrative agencies, Legal aspects.

The board of park trustees supervises the work of straightening, cleaning, deepening, or otherwise improving any natural watercourse with the city, even if used for sewer purposes. The board may purchase, acquire, or condemn any water rights, easements, or privileges in connection with any natural watercourse within the city and may acquire or condemn necessary real estate. (Powell-Florida)
W70-03580

LEVEES.

Tenn Code Ann secs 70-601 thru 70-623 (1956).

Descriptors: *Tennessee, *Levees, *Financing, *Local governments, Construction costs, Construction, Capitol, Government finance, Interest,

Principal, Overflow, Water levels, Flood damage, Administrative agencies, Taxes, Condemnation, Condemnation value, Cost repayment, Compensation, Judicial decisions.
Identifiers: *Bonds.

County courts may issue bonds for the construction of levees to protect potential overflow lands. These bonds must be approved by three-fourths of those voting in a regular election. A selected group of levee commissioners shall superintend the construction of the levee, contract for the work done, and draw bonds as needed, to pay for the construction. The county court shall levy a tax to pay the interest and the principal on the bonds. The commissioners may apply to the court for condemnation proceedings to obtain private land needed for the levees. The county court may then, following proper procedure, decree the land to the county, and a jury shall assess the compensation to be paid to the owner. Commissioners may receive subscriptions of money or property for the use of the county. Where the value of property is enhanced by the construction of levees, the county may retain such increment of taxes realized from this increased valuation. Funds so realized by the county shall be used to discharge bond indebtedness. (Dearing-Florida)
W70-03581

DRAINAGE AND LEVEE DISTRICTS.

Tenn Code Ann secs 70-701 thru 70-734 (1956).

Descriptors: *Tennessee, *Drainage districts, *Drainage systems, *Levees, Engineering structures, Drainage programs, Drainage engineering, Drainage, Land management, Drainage water, Drains, Natural streams, Water resources development, Natural resources, Stream improvement, Channel improvement, Costs, Cost-benefit theory, Cost allocation, Assessments, Railroads, Expenditures, Surveys, Mapping, Legislation, Legal aspects.

The county court of any county may establish drainage districts, construct any levee, drain or watercourse, and straighten, widen or change any natural watercourse, provided a petition, signed by persons who own a majority of the acreage to be affected, is filed with the court. A preliminary expense fund shall be created by assessing all landowners named in the petition. A disinterested engineer, appointed by the court, shall examine the lands described in the petition and shall submit a report setting forth a plat and profile of the improvements proposed in the petition, together with probable costs and other recommendations he may deem material. Ditches and drains shall be located along the general course of natural watercourses unless there is some special reason to depart therefrom. When any ditch or drain crosses any railroad right-of-way it shall be located at the place of the natural waterway, unless the railroad has provided for or agreed to another place. After the engineer's report has been filed, the court may make a special assessment upon all lands within the proposed district for expenses already incurred. (Smith-Florida)
W70-03582

ESTABLISHMENT OF DRAINAGE AND LEVEE DISTRICTS.

Tenn Code Ann secs 70-801 thru 70-809 (1956).

Descriptors: *Tennessee, *Drainage districts, *Levees, *Damages, Legislation, Drains, Ditches, Watercourses, Channels, Right-of-way, Condemnation, Drainage, Public benefits, Public health, Natural streams, Beds, Ownership of beds, Depth, Width, Compensation, Condemnation value, Legal aspects, Assessments.

Any person claiming damages as compensation for the construction of any improvements of the drainage district must file a claim three days before the hearing for the establishment of such district. If

any such claims have been filed, the county court shall not establish the district until the damages have been ascertained by the engineer and viewers appointed by the court. The viewers shall assess the damages that would be caused by establishing the district and report these to the court. Any incidental benefits to the landowner may be considered in estimating incidental damages, but the value of the land to be taken shall be given without deductions. The court shall consider the reported damages in deciding whether the levee or drainage district should be established. If the cost of construction is not too great a burden on the land to be benefited and the improvement is conducive to the public health, welfare or benefit, then the court shall establish the district. After the damages have been ascertained by the court, they shall be paid by the parties benefited by the district. In establishing any district, all necessary lands may be appropriated by condemnation and a right-of-way may be appropriated for any ditch, drain, or watercourse. The natural bed of such watercourse may also be appropriated. (Schram-Florida)
W70-03583

WATERS, DRAINS AND LEVEES (DRAINAGE DISTRICTS).

Tenn Code Ann secs 70-1301 thru 70-1340 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Administrative agencies, *Drainage districts, *Assessments, Legal aspects, Legislation, Adjudication procedure, Cost sharing, Appraisals, Drainage programs, Local governments, Cost allocation, Decision making, Project planning, Administrative costs, Maintenance costs, Taxes, Government finance.

The county court has the power to make a special assessment to pay costs and expenses made after creation of a drainage district. The collection and enforcement of such assessments are regulated. Procedures involving an appeal from an order of court fixing assessments are prescribed. The creation and operation of a special maintenance fund is regulated. Leved assessments are recorded by the county court clerk in the drainage assessment book. The vendee in a voluntary sale of property located within a drainage district must have the sale recorded in the drainage assessment book. Assessments become liens on leved bonds. The procedures for suits in chancery to collect assessments are established. The method of assessing public taxes for tracts partly within and partly without the drainage district limits is enumerated. Specific provisions cover the sale of land for public taxes, the distribution of proceeds from such sale and the right of redemption by the landowner. (Powell-Florida)
W70-03584

DRAINAGE SUBDISTRICTS.

Tenn Code Ann sec 70-1601 (1956).

Descriptors: *Tennessee, *Drainage districts, *Assessments, *Drainage, Legislation, Construction, Drainage systems, Benefits, Cost-benefit theory, Cost-benefit ratio, Damages, Taxes, Tax rate, Administration, Public benefits, Public health.

Any person owning lands within a drainage district, who desires to establish a subdistrict to secure more complete drainage, may file a petition with the clerk of the county court. The petition shall include a description of the lands to be affected by the subdistrict. The bond and all other proceedings, including the assessment of damages and benefits, shall be the same as for the establishment, formation, and construction of original districts and improvements. When established, the subdistrict shall become a part of the drainage system of the original drainage district and shall be under the control and supervision of the district board of directors. Such subdistricts may only be established when conducive to the public health or welfare, or to the public benefit or utility. Any special assessment for the benefit of a subdistrict shall be second-

Control of Water on the Surface—Group 4A

dary in lien and in right to the assessments of the original district. (Schram-Florida)
W70-03585

PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLICES).

Tenn Code Ann secs 43-2222 thru 43-2225 (1964).

Descriptors: *Tennessee, *Sluices, *Obstruction to flow, *Flow, Mills, Channels, Watercourses (Legal), Navigable waters, Rivers, Navigation, Boats, Diversion, Water management, Alteration of flow, Legislation, Legal aspects.

Identifiers: *Penalties (Civil), *Steamboats.

No person, upon the pretense of an exclusive right of navigation by steamboat, shall obstruct the passage of water in a sluice of a river on which a mill has been erected so as to affect the profitable enjoyment of the mill. Fines are provided for offenders who divert water from such sluices. Water may be diverted from sluices into the main channel in order to secure the immediate passage of boats, but such diversion shall not last longer than half a day. No person shall obstruct navigation of navigable waters on which exclusive navigational rights to steamboat have been given. (Duss-Florida)
W70-03592

STATE HIGHWAY SYSTEM.

Mo Ann Stat secs 227.080, 227.120, 227.140, 227.150 (1952).

Descriptors: *Missouri, *Highways, *Roads, *Bridges, Legislation, Local governments, Construction, Maintenance, Condemnation, Compensation, Damages, Navigable streams, Drainage ditches, Channels, Channel improvement, Water supply, Power plants, Highway relocation, Road construction, Access routes, Right-of-way, Bridge construction, Excavation, Grading, Administrative agencies.

Identifiers: *Highway maintenance.

Certain bridges built over navigable streams and intersecting state highways are declared to be part of the state highways. These bridges shall be maintained by the state Highway Commission. When necessary for the proper and economical construction and maintenance of state highways, the Highway Commission may purchase, lease, or condemn lands for the purpose of: (1) acquiring bridges or bridge sites and ferries over navigable streams; (2) changing the channels of any stream and providing necessary drainage ditches; (3) acquiring rights of way for locating, constructing, improving, or maintaining any state highway; (4) acquiring water supply and water power sites; (5) acquiring lands to deposit excess excavated material; (6) changing gradients in any state highway; (7) establishing detours in connection with state highway improvements; and (8) eliminating grade crossings. In any condemnation proceeding, the court shall take into consideration the benefits to be derived by the landowner as well as any damages sustained. (Schram-Florida)
W70-03603

INUNDATED HIGHWAYS.

Mo Ann Stat secs 227.270, 227.280 (1952).

Descriptors: *Missouri, *Highways, *Flooding, *Highway relocation, Legislation, Damages, Local governments, Compensation, Hydroelectric plants, Hydroelectric power, Power plants, Flood damage, Legal aspects, Administrative agencies, Construction, State governments, Safety, Negotiations.

Whenever the construction or operation of any water power or hydroelectric project results in the inundation of any portion of a state highway, the State Highway Commission may abandon that portion of the highway. The Commission may then

relocate as much of the highway as is necessary. Provisions as to these relocations are detailed. Whenever the construction or operation of any water power or hydroelectric project results in the inundation of any land or highway under the control and supervision of the Commission, the Highway Commission may negotiate and agree to a settlement with the responsible parties. All money received for damages from such settlements shall be deposited with the State Treasurer to the credit of the State Road Fund. (Schram-Florida)
W70-03604

MAINTENANCE OF PUBLIC ROADS.

Mo Ann Stat secs 231.080, 231.090, 231.100 (1952).

Descriptors: *Missouri, *Highways, *Maintenance, *Drainage, Legislation, Roads, Drains, Ditches, Water conveyance, Legal aspects, Real property, Obstruction to flow, Construction, Hydroelectric power, Hydroelectric plants, Powerplants, Flooding, Local governments, Jurisdiction, Compensation, Flood damage, Drainage practices, Drainage engineering.

Identifiers: *Highway maintenance.

The county highway engineer is authorized to contract with any owner of land adjacent to a public road for the purpose of opening any ditch for the drainage of the road. Reasonable compensation may be paid. These contracts shall be in writing and shall describe the lands on which said ditches or drains are situated. These contracts shall be signed by the landowner and recorded in the office of the county deed recorder. Whenever any ditch has been opened pursuant to this section, the road overseer or county highway engineer may enter upon such land at any time to remove any obstructions in the ditch. Any person obstructing these ditches so as to interfere with drainage purposes shall be guilty of a misdemeanor. Whenever the construction or operation of any power or hydroelectric project results in the inundation of roads other than state highways, the proper local officials having jurisdiction of such roads may make a settlement for the damages. All money received shall be credited to the road fund of the county or political subdivision. (Schram-Florida)
W70-03606

DAMS, MILLS AND ELECTRIC POWER.

Mo Ann Stat secs 236.010 thru 236.180 (1952).

Descriptors: *Missouri, *Dams, *Dam construction, *Electric power plants, Damsites, Non-navigable waters, Ownership of beds, Damages, Flood damage, Public health, Assessments, Judicial decisions, Legislation, Navigation, Fish barriers, Fish conservation, Fish passages, Mills, Milldams, Costs, Dam failure, Electric power, Hydroelectric plants, Overflow, Legal aspects.

Any person or corporation organized to operate mills, electric power works, or other machinery may erect a dam across any non-navigable watercourse if the proposed damsite is located on their land. If such person or corporation owns the land on one side of the watercourse and part of the streambed, they may also erect a dam. The procedures and petitions necessary to construct dams in the above instances are detailed. A jury shall be composed to determine: (1) damages from the proposed dam erection; (2) whether surrounding lands would be flooded; (3) whether navigation and the passage of fish would be obstructed; and (4) whether the health of the neighborhood would be materially affected. The findings of the jury shall be reduced to writing and, if there are objections to these findings, a regular civil trial shall determine the issues. The county circuit court shall grant or refuse the petition for a dam according to its judgment of what would be most reasonable and just under all circumstances. The privilege to erect a dam is subject to the conditions that: (1) all damages and valuations assessed by the jury shall

be paid; (2) the court imposed conditions as to obstructing navigation and the passage of fish shall be followed; (3) the dam and other machinery shall be completed within three years; and (4) the dam or machinery when destroyed or impaired, shall be repaired or rebuilt within three years. (Schram-Florida)
W70-03609

THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT.

North Carolina Water Resources Research Inst., Raleigh.

For primary bibliographic entry see Field 06B.
W70-03616

APPOINTMENT, POWERS, AND DUTIES OF DRAINAGE BOARD.

Wis Stat Ann secs 88.17, 88.21-88.22 (Supp 1969).

Descriptors: *Wisconsin, *Drainage districts, *Drainage, *Water management (Applied), Drainage systems, Drainage programs, Federal government, Administrative agencies, Water control, Drainage practices, Levees, Construction, Condemnation, Flood protection, Water conservation, Floodways, Legal aspects, Legislation.

When a petition is filed for organization of a drainage district in a county which does not already have a drainage board, the county court may create a drainage board and appoint resident landowners to board membership. The drainage board shall be empowered: to employ engineers and other assistants as advisors in drainage matters; to purchase, or with court permission, condemn lands necessary for construction or maintenance of drainage systems; to level spoil banks or excavated materials for agricultural or highway construction purposes; and to purchase or construct such levees, bulkheads, floodways, or pumping machinery as are necessary for successful drainage or protection of a district. Subject to approval by the court, the drainage board may enter into agreements with the federal government or an agency thereof to permit drainage of land owned by the United States. The board may also obtain federal loans and with state approval enter into contracts with the federal government to accept benefits of federal flood prevention laws and federal water conservation laws. (Kelly-Florida)
W70-03618

ORGANIZATION OF DRAINAGE DISTRICTS.

Wis Stat Ann secs 88.27-88.36 (Supp 1969).

Descriptors: *Wisconsin, *Drainage districts, *Drainage programs, *Administrative agencies, Drainage, Drainage systems, Construction costs, Cost allocation, Cost-benefit analysis, Drainage, Water control, Water management (Applied), Legal aspects, Legislation, Operation and maintenance, Permits, Control.

Owners of more than one-half of the land in a given area may petition for the organization of a drainage district to serve that area. An alternate method permits a majority of the landowners within a proposed drainage district, who own at least one-third of the included land area, to petition for organization of a district. Requirements relating to petition contents and filing procedure are set forth. Special procedures are established where drainage projects will affect navigable waters. The Public Service Commission must consent to the project, and extensive investigations of the proposed project must be undertaken by the drainage board before a permit to proceed may be granted. At any time prior to approval of the creation of a drainage district, a majority of the landowners, or those owning a majority of the land in the proposed district may petition the court to refrain from establishing a district. Following the organization

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

of drainage district, the drainage board shall proceed to lay out sufficient drains to carry out the drainage project, and shall assess benefits to the affected land, estimate costs and award damages where appropriate. (Kelly-Florida)
W70-03628

DRAINAGE (CONTROL OF WATER ON THE SURFACE: ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS).

Ill Ann Stat ch 42, secs 12-1 thru 12-24 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage districts, *Administrative agencies, *Surface drainage, Drains, Ditches, Spillways, Right-of-way, Condemnation, Easements, Structures, Bridges, Levees, Bridge construction, Highways, Railroads, Culverts, Flow, Flow control, Costs, Pumping plants, Wastes, Pipes, Environmental sanitation, Legislation, Inter-agency cooperation.

Identifiers: *Natural drains, Penalties (Civil), Fords, Penalties (Criminal).

Landowners within drainage districts have the right to use district drains for drainage of their land. Land within a district has the same rights of drainage as land outside of an organized district, except insofar as the drainage system varies from natural drainage. Landowners may continue to use land occupied by a district right-of-way in manners not inconsistent with the rights of the district. When a district drain crosses a railroad or highway, the district is liable for the construction of bridges or culverts necessitated by such crossing. Lands outside of a district may be included within it when construction of district works protects such lands. Civil and criminal penalties are provided for injuries to district structures and interference with the proper functioning of the district. The district commissioners shall cooperate with other governmental agencies in the exchange of information pertaining to drainage. This act is a consolidation of all previous state statutes relating to the organization and operation of drainage districts. (Duss-Florida)
W70-03633

MUNICIPAL CORPORATIONS (FLOOD PREVENTION).

Ind Ann Stat secs 48-4701 thru 48-4749 (1963), as amended, (Supp 1968).

Descriptors: *Indiana, *Administrative agencies, *Floods, *Flood control, Legislation, Regulation, Administration, Dams, Dikes, Diversion structures, Levees, Flood protection, Water management (Applied), Management, Planning, Costs, Construction costs, Condemnation, Financing, Taxes.

The board of public works of any first class city may adopt a resolution declaring the carrying out of flood control projects to be necessary for the general welfare. The board has the power to: construct dikes, levees, and retaining walls along rivers or streams; remove obstructions in channels; and construct and repair bridges. Other powers relevant to flood protection and water control are listed, and include the powers to: establish channel, bank, and harbor lines on rivers and streams; control the removal of obstructions; and regulate the construction of temporary bridges dikes, spillways, and dams. The board may condemn property needed for flood control purposes. A city and county tax levy to pay for bond issues is authorized. The organization of the Board of Flood Control Commissioners is set forth. The Commission has the power to: carry out flood control projects; construct dikes and levees; provide for disposal of excess reservoir water; and dredge, control or change the channel of streams. The county surveyor controls and manages all levees constructed. (Moulder-Florida)
W70-03634

WATER SUPPLY - SANITATION - DITCHES (ORGANIZATION AND PURPOSES OF CONSERVANCY DISTRICTS).

Ohio Rev Code Ann sec 6101.04 (Page 1953).

Descriptors: *Ohio, *Conservation, *Regulation, *Administrative agencies, Erosion, Streams, Lake Erie, Environmental sanitation, Water supply, Irrigation, Flood control, Legislation, State governments, Water conservation, Erosion control, Reservoirs, Land reclamation, Multiple-purpose projects, Sewage, Sewage systems, Sewage districts, Ditches, Irrigation ditches, Drainage engineering.

Any area or areas situated in one or more counties may be organized as a conservancy district. These districts shall be subject to conditions stipulated in other sections of this act. The following shall be the purposes of these districts: preventing floods; regulating stream channels by changing their dimensions; providing for irrigation where needed; reclaiming or filling wet and overflowed lands; regulating the flow of streams and diverting or wholly eliminating watercourses; providing a water supply for domestic use; collecting and disposing of sewage; and arresting erosion along the Ohio shoreline of Lake Erie. (Barnett-Florida)
W70-03643

4B. Groundwater Management

INJECTION WELL EXPERIENCE AT RIVER-HEAD, N.Y.

Baffa (John J.), New York.

John J. Baffa.

Journal of American Water Works Association, Vol 62, No 1, p 41-46, Jan 1970. 6 p, 9 fig, 5 ref.

Descriptors: *Injection wells, *Water reuse, *Recharge wells, Model studies, Reclaimed water, Aquifers, Water yield, Permeability, Recharge, Artificial recharge.

Identifiers: Well clogging, Well performance.

Injection of fresh potable water was studied in the field and laboratory to compare the hydraulic characteristics of the injection mound with the pumping drawdown characteristics. Injection requires establishment of a boundary pressure for entrance of the injection water into the aquifer pores. Injection was accomplished in two ground wells of different design and in two wells contained in a ground simulator tank so constructed as to permit the sampling of the aquifer material opposite the well screen after pumping, injection and redevelopment. The clogging rate of the double-cased well was less than that of the single-cased well by 0.06 ft per day as measured by the water level inside the casing. The initial specific capacity of the double-cased well was about half of the well with the gravel pack, but after fresh water injection and reclaimed waste water injection it was possible to restore its initial capacity by surging and pumping. After reclaimed waste water injection into the single-cased well its specific capacity was markedly reduced and could not be restored. (Knapp-USGS)
W70-03249

HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO,

Geological Survey, Boise, Idaho.

For primary bibliographic entry see Field 02F.
W70-03254

FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER,

Asian Inst. of Technology, Bangkok (Thailand). Dept. of Engineering.

Hung Tao Shen.

Master of Engineering Thesis, No 248, Asian Institute of Technology, 1969. 62 p, 10 fig, 3 tab, 22 rcf.

Descriptors: *Dimensional analysis, *Aquifers, *Flow, Drains, Fresh water, Saline water, Piezometers, Withdrawal, Pumping, Pump testing, Boundary processes, Density, Water level.

Identifiers: *Coastal aquifer, Two-dimensional study.

A two-dimensional study was made of flow conditions caused by pumping from a fresh-water aquifer bounded on the lower surface by a stationary fluid of higher density (saline water) and on the upper surface by a horizontal plane having a constant piezometric head. Withdrawal of fresh water was accomplished by continuous pumping from a series of line sinks or drains spaced at periodic intervals in the fresh water area. Pumping produced interface upconing in the vicinity of the line sink. A general rising of the level of the fresh water-salt water boundary resulted when compared to conditions which existed prior to pumping. The results of mathematical analysis describing flow conditions is presented graphically in dimensionless form. (Carstea-USGS)
W70-03257

GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA,

Geological Survey, Phoenix, Ariz.

P. C. Briggs.

Arizona State Land Department Water-Resources Report No 41, Sept 1969. 28 p, 7 fig, 4 tab, 8 ref, 1 append.

Descriptors: *Water resources, *Arizona, *Groundwater, *Groundwater basins, Water wells, Aquifers, Water yield, Water quality, Irrigation water, Irrigation, Water levels, Water level fluctuations, Hydrologic data, Data collections, Hydrogeology.

Identifiers: Yuma County (Ariz.).

In the Ranegras Plain, Arizona, nearly all the cultivated acreage and groundwater pumped are within an area of about 200 square miles north of U.S. Highway 60-70 and south of Bouse. The first large irrigation wells were drilled in the plain in 1948. By spring 1949, about 1,000 acres were being irrigated; by 1957 the amount of land being irrigated had increased to 5,200 acres, but by 1967 only 2,800 acres were being irrigated. From 1948 through 1967, about 211,000 acre-ft of groundwater was pumped in the Ranegras Plain. Changes in water level resulting from the pumping have been minor to the present time (1967). Water levels have declined more than 15 ft in only a small part of the area; declines in water level of from 10 to 15 ft have occurred in a fairly large area. The groundwater in the Ranegras Plain contains varying amounts of dissolved minerals and is considered permissible to unsuitable for irrigation. (Knapp-USGS)
W70-03267

A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS,

For primary bibliographic entry see Field 02F.

W70-03274

GROUNDWATER RESOURCES OF ASH SHATI AREA, KINGDOM OF LIBYA,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02F.

W70-03306

WATER WELLS.

Tenn Code Ann secs 70-2301 thru 70-2310 (Supp 1969).

Descriptors: *Tennessee, *Water wells, *Drilling, *Well regulations, Wells, Well permits, Permits, Underground, Groundwater, Water sources, Water supply, Conservation, Administration, Administrative agencies, Regulation, Legal aspects, Water

Identification of Pollutants—Group 5A

policy, Water conservation, Water resources, Legislation, Water management (Applied).

Every person who intends to drill or dig a water well within the state shall annually obtain a state license. It shall be unlawful for any person to drill or dig a water well within the state without being licensed, posting a certificate furnished by the Commissioner of Conservation and filing a 'report of well driller' after the completion of each well. All water well drilling must be supervised and managed by a licensed water well driller. Well drilling licenses may be suspended or revoked for enumerated reasons. The Commissioner of Conservation is authorized to make and publish such rules and regulations as he deems necessary to effectuate this chapter. A Board of Ground Water Resources is hereby created in order to advise and assist the Commissioners in preparation of rules and regulations governing water well drilling. This chapter applies solely to wells drilled for the production of water. Any violation of this chapter shall be a misdemeanor. (Smith-Florida)
W70-03424

RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH,

Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.

For primary bibliographic entry see Field 02F.

W70-03454

4C. Effects on Water of Man's Non-Water Activities

GREAT SALT LAKE, UTAH: CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966,

Geological Survey, Salt Lake City, Utah.

For primary bibliographic entry see Field 02H.

W70-03279

MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL,

Wright-McLaughlin Engineers, Denver, Colo.

Kenneth R. Wright.

Paper presented at International Conference on Floods: Their Protection and Defense of the Soil, held by the Accademia Nazionale Dei Lincei, Rome, Italy, Nov 1969. 28 p, 24 ref.

Descriptors: *Flood control, *Planning, *Drainage systems, *Drainage engineering, Storm drains, Storm runoff, Drainage programs, Hydraulic structures, Water policy, Floodproofing, Flood protection.

Most urban areas are faced with a flood problem that receives little official recognition, the urban drainage problem. Urban drainage is usually very localized, although it is believed that damages due to urban drainage problems are equal to report flood losses. AN EFFECTIVE WAY TO DEAL WITH THIS PROBLEM IS BY A MULTIPLE MEANS EFFORT BASED ON A BASIC URBAN DRAINAGE POLICY. This policy should be formulated in light of various inputs; principles of urban drainage, hydrology and hydraulics of small urban basins, and accurate knowledge of urban drainage law. Urban drainage policy must also recognize that urban drainage is directly related to the total urban system and that when it is deficient, adverse effects occur in other subsystems. The planning process is based on the concept of two urban drainage systems. The initial drainage system, typically storm sewers, is designed to handle storm runoff expected to occur once every 2-10 years. The major drainage system is the area which must accommodate the 100-year runoff and includes both natural and artificial elements. Other specific aspects of urban drainage planning discussed are functions of storm sewers and streets,

hydraulic structures, inlets and culverts, storage, and floodproofing. (Davis-Chicago)
W70-03343

WATER RESERVOIR SYSTEMS.

Autonetics Division of North American Rockwell Corporation, Anaheim, California, Life Sciences Operations.

For primary bibliographic entry see Field 04A.
W70-03435

WATER AND MAN: A WORLD VIEW,
Geological Survey, Washington, D.C. Water Resources Div.

For primary bibliographic entry see Field 06G.
W70-03450

ARROGANCE TOWARD THE LANDSCAPE: A PROBLEM IN WATER PLANNING,
Geological Survey, Washington, D.C. Water Resources Div.

For primary bibliographic entry see Field 06G.
W70-03465

4D. Watershed Protection

CONSERVATION OF NATURAL RESOURCES (SHORE EROSION).

Ohio Rev Code Ann secs 1507.01 thru 1507.13 (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Beach erosion, *Shore protection, *Erosion control, Legislation, Legal aspects, Shores, Erosion, Construction, Structures, Permits, Riparian land, Financing, Rivers and Harbors Act, Administrative agencies, Natural resources, Water resources, Federal government, Lake Erie, Investigations, Navigable waters, Taxes, Mineralogy, Watercourses (Legal), Cost allocation, Contracts, Planning, Recreation.
Identifiers: Groins.

The Office of the Chief Engineer of the Department of Natural Resources will act as the erosion agency of the state for purposes of complying with the Rivers and Harbors Act. The Office will cooperate with the Federal Beach Erosion Board in conducting investigations and studies along the shores of Lake Erie with a view to erosion prevention and correction. Navigable waters, for the purpose of this section, means waters within the jurisdiction of the Board and any waterways within or adjacent to the state. No person will construct a beach or any other erosion arresting structure on the shores of Lake Erie without a permit from the Office. Funds for erosion projects will be obtained from permit sales and Lake Erie mineral leases. The Office may enter into agreements with any political subdivision for the purpose of constructing and maintaining projects to prevent, correct, and arrest erosion on specified beaches. Cost allocation formulas are provided for the different governmental subdivisions. The Chief Engineer in cooperation with the Division of Geological Survey, will prepare a plan for the prevention of shore erosion in the state. (Keith-Florida)
W70-03405

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

For primary bibliographic entry see Field 05C.
W70-03244

NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION,

Maryland Univ., College Park. Dept of Civil Engineering; and Federal Water Pollution Control Administration, Washington, D.C.

Francis B. Birkner, and J. K. Edzwald.

Journal of American Water Works Association, Vol 61, No 12, p 645-651, Dec 1969. 7 p, 6 fig, 5 tab, 21 ref.

Descriptors: *Water chemistry, *Flocculation, *Clays, Chemical precipitation, Coagulation, Ion exchange, Desilting, Water treatment.
Identifiers: Polyethylene oxide.

In a search for more efficient flocs, the chemical and physical mechanisms which are involved in the destabilization of kaolinite clay suspensions with a nonionic polymer, were examined. Polyethylene oxide was specifically tested as a flocculant. Solution pH and the type of counterion which predominates in the solution phase have a significant effect on the adsorption of polyethylene oxide onto kaolinite clay surfaces. Under conditions of constant ionic strength and at pH 8.3, twice as much polymer adsorption occurs when sodium ions are the predominant cation species in the solution phase than when calcium ions predominate. Adsorption is significantly reduced by raising the solution pH from 8.3 to 12 or by lowering it to 2.5. Polyethylene oxide was found to enhance turbidity removal when used in conjunction with sodium (Water I) or calcium (Water II) ions. (Knapp-USGS)
W70-03265

HYDROGEN SULFIDE ODOR THRESHOLD,

Pomeroy, Johnston and Bailey, Pasadena, Calif. Richard D. Pomeroy, and Henry Cruse.

Journal of American Water Works Association, Vol 61, No 12, p 677, Dec 1969. 1 p, 1 tab.

Descriptors: *Odor, *Hydrogen sulfide, *Water quality, Laboratory tests, Water chemistry, Hydrogen ion concentration.
Identifiers: *Hydrogen sulfide odor determination.

Tests were made to ascertain the minimum concentration at which the odor of hydrogen sulfide in water can be detected. A panel of five observers was used, only one of whom had prior experience in odor testing. The odor threshold concentration of hydrogen sulfide in water at ordinary temperatures is in the range of 10 to 100 nanograms/liter (0.00001 to 0.0001 mg/l). It is noteworthy that the odor that one detects at very low hydrogen sulfide concentrations is musty or swampy, not recognizable as being related to the characteristic odor at higher concentrations. A musty odor is often complained of in anaerobic groundwaters. Hydrogen sulfide is a characteristic constituent of such waters, typically at concentrations below 0.1 mg/l. (Knapp-USGS)
W70-03275

DETERMINING pH OF STRIP-MINE SPOILS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.

W. A. Berg.

US Forest Service Research Note NE-98, 1969. 7 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Hydrogen ion concentration, *Acidic soils, *Strip mine wastes, *Analytical techniques, Mine wastes, Acidic water, Acid mine water, Water pollution sources.
Identifiers: Strip mine spoils.

In determining pH of strip-mine spoil, results with the LaMotte-Morgan method for determining soil pH (or the solution modification of this method) usually agreed fairly well with the results from using a pH meter, the recognized standard. Results obtained with the Soiltex and Hellige-Truog methods often deviated somewhat from the pH meter readings; and the Hydron papers and the Kelway pH tester often gave results that were considerably different. (Knapp-USGS)
W70-03281

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification of Pollutants

MEASUREMENT OF PHOSPHORUS IN WASTEWATER,

Belgrade Univ. (Yugoslavia) and Washington Univ., St. Louis, Mo. Dept. of Civil and Environmental Engineering.

Stevan G. Jankovic, Dee T. Mitchell, and James C. Buzzell, Jr.

Water and Sewage Works, Vol 114, No 2, p 471-474, 1967. 2 fig, 3 tab, 11 ref, appendix.

Descriptors: *Analytical techniques, *Sewage,

*Phosphorus, Filtration, Industrial wastes, Sewage.

Identifiers: Orthophosphates, Phosphorus (Total), Dry-ashing, Polyphosphates, Murphy-Riley method, Domestic sewage.

Method of phosphorus determination in sewage waters in utilizing ascorbic acid as a reducing agent thereby avoiding complications caused by the use of stannous chloride is described. Neither pH value of the medium, nor additions of small amounts of oxidizing or reducing agents produced appreciable modification of results. Results comparable to dry-ashing were obtained by wet oxidation with potassium persulfate. The method is intended for analysis of domestic sewage and the results may be distorted by the presence of certain ingredients of industrial discharges. (Wilde-Wisconsin)
W70-03331

NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA,

North Carolina Water Resources Research Inst., Raleigh.

James R. Bohannon, Jr., Kuruvilla Verghese, and Jack N. Weaver.

Available from the Clearinghouse as PB-189 161, \$3.00 in paper copy, \$0.65 in microfiche. Report No 31, Water Resources Research Institute of The University of North Carolina, Dec 31, 1969. 142 p, 21 tab, 43 fig. OWRR Project A-0390-NC.

Descriptors: *Analytical techniques, *Water analysis, *Neutron activation analysis, Neutron spectroscopy, Neutron absorption.

A deliberate exploratory study and pilot plant type series of analysis were carried out to determine the applicability of neutron activation analysis (NAA) to water resources research and management in North Carolina. A review of the water pollution problems and programs was made to establish the background for determining this applicability. An explanation of the NAA technique is presented to prepare the reader for an understanding of the character of past water pollution programs and studies which employed the NAA technique. With this basic understanding established, applicability of NAA to North Carolina water resources problems was identified and specific exploratory analysis were performed. The categories of analysis were: the determination of baseline for trace elements in both virgin and contaminated rivers within the State, the establishment of minimum detection limits of specific trace elements of concern to the State by seeding the original water samples, and the performance of in-line process analysis for several industries. It was found that instrumental NAA could indeed be used to establish meaningful baselines for the water sources in the State, the minimum detectable limits were equal to or better than conventional methods in most cases, and NAA could serve a major role in the solution of water pollution problems and abatement within the desired criteria of routine, inexpensive and rapid analysis. The latter is particularly useful to the industries of the State in their efforts to recover wastes and to minimize their release by in-line process analysis. The detection problems and levels of specific types of pollutants; namely, pesticides, herbicides, and fungicides were explored. Specific recommendations were given on the future application of NAA to North Carolina water resources management. An extensive bibliography was developed. (Howells-North Carolina Univ)
W70-03351

IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE: WATER QUALITY,

Hawaii Univ., Honolulu. Water Resources Research Center.

For primary bibliographic entry see Field 05B.

W70-03430

A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA,

North Carolina State Univ., Raleigh. Pesticide Residue Research Lab.

For primary bibliographic entry see Field 05B.

W70-03437

OFFSITE RADIOLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968,

Southwestern Radiological Health Lab., Las Vegas, Nev.

John R. McBride, and Dixon Hill.

Radiological Health Data and Reports, Vol 10, No 12, p 535-546, Dec 1969. 12 p, 7 fig, 7 tab, 2 ref.

Descriptors: *Nuclear explosions, *Water pollution sources, *Radioactivity, *Monitoring, Sampling, Nuclear engineering, Underground, Natural gas, Water wells, Oil fields.

Identifiers: Project Gasbuggy.

Project Gasbuggy, an experiment to stimulate gas recovery by nuclear means, was conducted on December 10, 1967, as part of the Atomic Energy Commission's (AEC) Plowshare Program. The Public Health Service by Memorandum of Understanding with the AEC is responsible for a comprehensive offsite radiological safety program. The data obtained during this program have documented that no radioactivity was introduced into the environment as a result of the Project Gasbuggy detonation. Surveillance of the El Paso natural gas producing wells near the Gasbuggy experiment was conducted to insure that gas contaminated with radioactivity was not present. Water sampling coverage during the preshot and post-shot periods was provided by a network of 34 sampling stations. Fifteen of the sampling locations were within 20 miles of ground zero at open- and well-water sources, and 13 of the locations were milk cow sampling stations. Six of the network locations were municipal water systems located within approximately 120 miles from ground zero. (Knapp-USGS)
W70-03452

DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,

Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Cunningham Lab.

I. P. Little, R. Reeve, G. M. Proud, and Ann Lulham.

Journal of the Science of Food and Agriculture, Vol 20, No 11, p 673-676, 1969. 2 fig, 3 tab, 8 ref.

Descriptors: *Analysis, *Sulfur, Surface waters, Soil water, Plant tissues, Spectrophotometry, Analytical techniques.

Identifiers: *Dissolved sulphate.

A simple method for rapid determination of sulphate in surface waters and soil water extracts has an accuracy of 1 part per million. The sulphate is precipitated with a solution of lead nitrate in 40% ethanol. The residual lead is determined by atomic absorption spectrophotometer. Analysis of plant tissues requires conversion of sulphur to dissolved sulphate by combustion in an oxygen-filled flask. (Wilde-Wisconsin)
W70-03502

DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS,

Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography; and Washington Univ., Seattle. Dept. of Oceanography.

For primary bibliographic entry see Field 05B.

W70-03503

HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA,

California Univ., Davis. Dept. of Zoology.

Roger W. Bachman, and Charles R. Goldman. Limnology and Oceanography, Vol 10, No 2, p 233-239, Apr 1965. 4 fig, 1 tab, 13 ref.

Descriptors: *Thermal stratification, *Solar radiation, *Hypolimnion, *Turbulent flow.

Identifiers: *Eddy conductivity.

Calculations were made of the coefficient of eddy conductivity by making use of a series of summer temperature profiles of a small mountain lake. An electrical resistance thermometer was used to measure water temperature at a station in the deepest portion of the basin. A minimal series included temperatures at 1-m intervals from the surface to 10-m and at 5-m intervals from 10-m. to the bottom. Solar radiation was measured with a pyrheliograph and pyrheliometer, water transparency was with a Secchi disc and light penetration was measured by a G.M. underwater photometer with various Schott light filters. The relatively high value obtained (0.0622g/cm/sec) prompted an evaluation of the role of direct solar heating in the hypolimnion using data on total daily solar radiation, the spectral curve of sunlight, and the light transmission properties of the lake water. An estimated 65-85% of the heating in the upper hypolimnion could be accounted for by direct solar heating. It is postulated that in Castle Lake, direct solar heating rather than turbulent mixing is responsible for the shape of the hypolimnetic thermal profile. (Guerrero-Vanderbilt)
W70-03551

5B. Sources of Pollution

SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,

Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

For primary bibliographic entry see Field 05C.

W70-03244

GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA,

Ontario Water Resources Commission, Toronto.

M. D. Palmer, and J. B. Izatt.

Ontario Water Resources Commission Final Report on Great Lakes Water Quality Surveys Program, 1969. 57 p, 13 fig, 11 tab, 8 ref, 2 append.

Descriptors: *Dispersion, *Currents (Water), *Great Lakes, *Current meters, *Mathematical models, Waste dilution, Data collections, Hydrologic data, Mixing, Sewage disposal, Thermal pollution, Heated water.

Identifiers: Nearshore currents (Great Lakes).

Methods for the prediction of the dispersion patterns resulting from the continuous discharge of waste in the nearshore areas of lakes are developed. These methods are based upon the analysis of recording current meter records. The long-term dispersion characteristics are presented as monthly mean concentration contours for various discharges. The short-term characteristics are presented as five-hour probabilities and dilution rates for the four major compass directions. (Knapp-USGS)
W70-03253

Sources of Pollution—Group 5B

KARSTIC WATER RESEARCH IN HUNGARY,
Research Inst. for Water Resources Development,
Budapest (Hungary). Karstic Water Research Section.

For primary bibliographic entry see Field 02F.
W70-03264

QUALITY OF SURFACE WATERS OF SOUTH CAROLINA: A SUMMARY OF DATA, 1945-1968,

Geological Survey, Columbia, S.C.
T. Ray Cummings.

Copies of report may be obtained from U.S. Geological Survey, Water Resources Div, 2346 Two Notch Road, Columbia, S.C. 29204. Geol Surv Basic Data Open-file Report, 1969. 34 p, 4 fig, 1 plate, 3 tab, 15 ref.

Descriptors: *Water quality, *South Carolina, *Data collections, Hydrologic data, Water chemistry, Solutes, Mineralogy.

Identifiers: Water quality data.

Maximum and minimum values of dissolved substances and physical properties of surface water at 81 locations in South Carolina are tabulated. Most dissolved substances are in low concentration, and measured values of physical properties are low. At most sampling stations dissolved-solids content does not exceed 100 mg/l. South Carolina is divided into two water-quality zones, which generally correspond to the Piedmont province and Coastal Plain province of the State. Minor but distinct differences between water of these zones occur. Water of the Piedmont province contains slightly more dissolved solids, particularly silica, sodium, and bicarbonate, than does water from the Coastal Plain province. The pH of water in the Piedmont province is also slightly higher. The color of water, however, averages about 100 units higher in the Coastal Plain province than in the Piedmont province. (Knapp-USGS)

W70-03266

WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH),

Rijksinstituut voor Zuivering van Afvalwater, Voorburg (Netherlands).

W. A. H. Brouwer.

H2O, Vol 2, No 17, p 400-402, Aug 21, 1969. 3 p, 2 fig, 1 photo, 1 map, 5 ref.

Descriptors: *Water quality, *Estuaries, *Delaware River, *Delaware River Basin Commission, *Water quality control, Estuarine fisheries, Estuarine environment, Regulation, Legislation, Legal aspects, Interstate, Water resources development, Planning, River basin commissions, Maryland, New Jersey, New York, Pennsylvania.

Identifiers: *Delaware River Basin.

The Delaware River drains a region of ample water resources. A multiplicity of water quality management problems exist encompassing protection of municipal and industrial water supplies, acid mine drainage control, recreation and water sports, saline waters encroachment in a tidal estuary, natural shellfish beds in Delaware Bay, maintenance and propagation of resident fish, passage of anadromous fish and the discharge and ultimate disposal of the generally treated wastes from 6.5 million people and numerous industries. In 1961 a compact gave rise to the Delaware River Basin Commission, formed by the four Basin States and the Federal Government. Part of the Commission's responsibilities in the maintenance of a Comprehensive Plan of water resource development, including water quality management. A 5-year study in the complex estuary provides a framework for decisions which will protect the desired uses as well as allow reasonable waste discharges. (Knapp-USGS)

W70-03269

POSSIBILITIES FOR MINERALIZATION OF PESTICIDES (DUTCH),

For primary bibliographic entry see Field 05G.

W70-03271

POISONING THE WELLS.

Committee for Environmental Information, St. Louis, Mo.

Environment, Vol 11, No 1, p 16-23, 45, Jan-Feb 1969. 9 p, 5 fig, 2 photo.

Descriptors: *Water chemistry, *Leaching, *Nitrates, *Fertilizers, Water pollution sources, Irrigation, Irrigation water, Irrigation practices, Nitrogen compounds, California.

Identifiers: Delano (Calif), Drinking water.

Nitrate contamination of well water in the vicinity of Delano, California is caused by leaching of agricultural fertilizer from the soil by irrigation water. About 450 lbs of fertilizer is applied to each irrigated acre. Without proper drainage facilities, contamination will increase. Nitrate contamination is now so high that municipal water system managers had to issue warnings against use of their water for infants. (Knapp-USGS)

W70-03276

IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE: WATER QUALITY,

Hawaii Univ., Honolulu. Water Resources Research Center.

Pedro A. Tenorio, Reginald H. F. Young, and H. Collins Whitehead.

Available from the Clearinghouse as PB-189 171, \$3.00 in paper copy, \$0.65 in microfiche. Hawaii Water Resources Research Center, Technical Report No. 33, Oct 1969. 90 p, 2 tab, 28 fig, 39 ref. OWRR Project B-012-HI.

Descriptors: *Groundwater, Nitrates, Dissolved solids, *Return flow.

Identifiers: *Irrigation return water, Pearl Harbor-Waipahu (Oahu), Kahuku (Oahu), Central Maui, West Maui.

A joint research effort was undertaken by the Water Resources Research Center and the Honolulu Board of Water Supply to investigate the physical and chemical characteristics of irrigation return water in Pearl Harbor-Waipahu, Oahu, which is an area used for tropical agriculture. The project was started in 1967 and was expanded in 1968 to include Kahuku, Oahu and Central and West Maui. Well samples and profile samples were obtained with a thief sampler in the Pearl Harbor-Waipahu area and composite samples were obtained mainly from pumping wells in other areas. In addition, both spring and stream waters in the Pearl Harbor-Waipahu area were analyzed for a number of inorganic constituents. Stream waters in the main study area were observed to contain appreciable quantities of nitrate, phosphate, bromide, bicarbonate, and fluoride. Similar trends were observed with the spring samples including increases of calcium, magnesium, silica, sulfate, and nitrate. Well waters from the main study area were evaluated according to Visher and Mink's index constituents, silica, sulfate, and nitrate, and other significant ionic compositions. General analysis of major constituents evidenced a cyclical trend in concentration, either related to seasonal rainfall and irrigation practices, or both. (WRSC-Abstract)

W70-03430

OXYGENATION OF FERROUS IRON: THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE,

Harvard Univ., Cambridge, Mass. Dept. of Applied Chemistry.

Philip C. Singer, and Werner Stamm.

Available from the Clearinghouse as PB-189 233, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-28, June 1969. 199 p, 63 fig, 10 tab, 122 ref, 6 append. FWPCA Contract PH 36-66-107. Program 14010.

Descriptors: *Acid mine water, *Oxidation, *Pyrite, *Iron bacteria, *Chemical reactions, Water chemistry, Mine acids, Water pollution sources, Acidic water, Reduction (Chemical), Hydrogen ion concentration, Oxidation-reduction potential, Sulfides, Iron.

Identifiers: Reaction kinetics.

The rate of oxidation of iron (II) by oxygen conforms to a relationship which is first-order in the concentrations of ferrous iron and oxygen, and second-order in the concentration of hydroxide ion, at pH values between 6.0 and 7.5. The reaction proceeds relatively rapid at pH values greater than 6.5; the half-time of the reaction is 4 minutes at pH 7.0, under a partial pressure of oxygen of 0.20 atmospheres at 25 deg C. The dependence of the oxidation rate on hydroxide concentration has been observed, in this study, at pH values as low as 4.5, where the half-time has increased to approximately 300 days. At lower pH values, the dependence of the reaction rate on pH becomes less marked until at pH values below 3.5, the oxidation proceeds at a rate which is independent of pH. Field results suggest that the observed rapidity of the reaction in acidic mine waters is apparently the result of microbial catalysis. The rate-limiting step among the reactions involved in the oxidation of iron pyrite and the production of acidity in mine drainage waters is the oxygenation of ferrous iron. Oxidation of iron pyrite is by a cyclical reaction involving the slow oxygenation of iron (II) to iron (III) followed immediately by the rapid reduction of iron (III) by pyrite, generating in turn more iron (II) and acidity. (Knapp-USGS)

W70-03434

A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA,

North Carolina State Univ., Raleigh. Pesticide Residue Research Lab.

T. J. Sheets, M. D. Jackson, and L. D. Phelps. Available from the Clearinghouse as PB-189 291, \$3.00 in paper copy, \$0.65 in microfiche. Progress Report No. 19, Water Resources Research Institute of The University of North Carolina, Feb 6, 1970. 105 p. OWRR Project A-021-NC.

Descriptors: *Pesticides, *Pesticide monitoring, *Water quality, *Pesticide residues, Insecticides, Herbicides, *Chlorinated hydrocarbons, DDT, TDE, DDD, Phenoxy herbicides, 2,4-D, 2,4-5-T, Trifluraline, Pollutants, Water, Sediment, Estuaries, Pesticide use estimates.

Identifiers: *Phenoxy acetates, *Water and sediment.

A procedure for monitoring surface waters in North Carolina for pesticides was devised and tested in the Tar-Pamlico River. Sites, positions in the river, frequencies, and kinds of samples were evaluated. Samples of sediment and water were routinely taken from the river and from selected sites in estuaries and sounds and analyzed by electron-capture gas chromatography for p,p'-DDT, p,p'-TDE, o,p-DDT, p,p'-DDE, and dieldrin. The p-value was evaluated as a method of confirmation. The low limits of detection of each of the pesticides were 10 ppt and 4 ppb for water and sediment, respectively. The percent positive values in sediment were 10 to 10,000 times greater than levels in water. Systems for sampling and analyzing water and sediment for chlorinated hydrocarbons, organic phosphates, phenoxy acetates, and trifluraline were outlined, and minimum personnel and equipment needs for operation of the monitoring system were listed.

W70-03437

A NEW POLLUTION PROBLEM,

Committee for Environmental Information, St. Louis, Mo.

Sheldon Novick.

Environment, Vol 11, No 4, p 2-9, May 1969. 8 p, 3 photo, 2 tab.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

Descriptors: *Water pollution sources, *Pesticides, *Fungicides, Metal organic pesticides, Pesticide toxicity, Poisons, Public health.
Identifiers: Mercury compounds.

Mercury pesticides are widely used in agriculture and potentially can result in toxic residues in foods. These pesticides and fish contaminated by them have been banned in Sweden; the pattern of use in the U. S. is like that in Sweden before the ban. Mercury pesticides manufacturers, trade names, and national use of mercury pesticides are tabulated. It is recommended that mercury tolerances and concentration in water, air, and food be given thorough study. (Knapp-USGS)
W70-03456

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES,

Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.

Alvin S. Goodman, and Richard J. Tucker.

Available from the Clearinghouse as PB-189 293, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report No ORD-6, July 1969. 121 p, 17 fig, 10 tab, 71 ref, 4 append. FWPCA Grant No WP-01090, FWPCA Program No 16090.

Descriptors: *Water quality, *Water pollution control, *Mathematical models, Computer programs, Dissolved oxygen, Biochemical oxygen demand, Waste water treatment, Waste dilution, Statistical methods.

Identifiers: *Sensitivity analysis.

Mathematical models were utilized to study water pollution control programs in a river basin. Sensitivity analyses, with a steady state model, showed substantial variation of cost for sewage treatment, depending upon stream purification parameter selections. When actual parameters are less favorable than design values, quality standards may not be met. An unsteady state model was developed to trace a time profile at any specified station in terms of flow and quality as BOD, dissolved oxygen, coliforms, and chlorides while upstream discharge, water temperature, and solar radiation vary. A new empirical procedure was developed to route unsteady stream flow. The time varying model was used to investigate the effectiveness of treatment when the stream's assimilative capacity varies with distance and time. DO values are worse at times than the steady state value, and susceptibility to poorer conditions increases with higher BOD releases. (Knapp-USGS)
W70-03488

CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE,

Eastern New Mexico Univ., Portales. Dept. of Biological Sciences.

Philip A. Buscemi.

Oikos, Vol 20, No 1, p 119-127, 1969. 3 fig, 3 tab, 30 ref.

Descriptors: *Runoff, *Groundwater, *Seston, *Sediments, Organic matter, Currents (Water), Water pollution sources, Surface runoff, Rainfall, Snowmelt, Surface waters, Streams, Hydrogen ion concentration, Iron, Magnesium, Nitrates, Phosphates, Algae, Detritus, Pulp wastes, Livestock, Idaho.

Identifiers: Tree bark, Charcoal, Algal growth, Stream confluence, Palouse River (Idaho).

Water and sediment samples were collected at four stations established on Palouse River, Idaho. Determinations included pH, nitrate, phosphate, iron, manganese, hardness, suspended detritus (drifting seston), and organic content of sedimentary deposits. The results show influence of rainfall, melt water, stream inflow, and mill pond on seston concentration. Variation in chemical composition of water indicated the effect of either melt water runoff or subterranean discharge. The increased

pollution of water and sediment enrichment in organic matter were correlated with locations of lumber camps and cattle grazing. (Wilde-Wisconsin)
W70-03501

DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS,

Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography, and Washington Univ., Seattle. Dept. of Oceanography.

Donald D. Adams, and Francis A. Richards.

Deep-Sea Research, Vol 15, p 471-481, 1968. 3 fig, 6 tab, 27 ref.

Descriptors: *Organic matter, *Oxygenation, Anaerobic bacteria, Sea water, Test procedures, Separation techniques.

Identifiers: *Lake Nitinat (Vancouver Island), Anoxic waters, Mercaptans, Dissolved organic matter, Polar constituents, Solvent extraction, Thin-layer chromatography, Oxidation potential, Organic carbon, Desulfovibrio desulfuricans.

From 40 to 60% of dissolved organic carbon was recovered from acidified sea water by extraction with petroleum ether and ethyl acetate. Oxygen-bearing waters yielded 1.0-1.2 milligram/liter of dissolved organic matter whereas deoxygenated waters yielded 1.8-1.9 milligram/liter. Increase in the content of organic matter was accompanied by the presence of nonpolar and polar nonvolatile mercaptans. Tentatively identified sterols or sterol esters, choline-containing lipids, and ninhydrin-positive compounds were found in both oxygenated and anaerobic waters. Observations may have bearing upon the distribution of higher forms of life. (Wilde-Wisconsin)
W70-03503

THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN,

Toronto Univ. (Ontario). Dept. of Geology, and Wisconsin Univ., Madison. Dept. of Geology and Geophysics.

Jerome O. Nriagu, and Carl J. Bowser.

Water Research, Vol 3; p 833-842, 1969. 4 fig, 5 tab, 12 ref.

Descriptors: *Pollutant identification, *Water pollution, *Lakes, Lake soils, Sedimentation, Diagenesis, Sediments.

Identifiers: *Lake Mendota (Wis), INA method, Magnetic microspheres, Lake muds, Sedimentation pattern.

Analyses of magnetic microspheric particles from the bottom mud of Lake Mendota, Wisconsin, suggest that these intrusions are by-products of either industrial or domestic activity. Washing the atmosphere, influent of streams, and urban runoff are possible channels of transportation. The profile distribution of these resistant spherules eliminates their extraterrestrial origin and documents the progressive pollution of the lake by man. (Wilde-Wisconsin)
W70-03504

PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA,

Ohio State Univ., Columbus. Dept. of Microbiology, and Ohio State Univ., Columbus. Aquatic Biology Lab.

Robert M. Pfister, Patrick R. Dugan, and James I. Freia.

International Association of Great Lakes Research, Proceedings 11th Conference Great Lakes Research, p 111-116, 1968. 6 fig, 2 tab, 11 ref.

Descriptors: Aquatic environment, Water quality control, Ecosystems, Biological communities, Detritus, Chemical properties, Interfaces, Adsorption, Electron microscopy, Biocontrol.

Identifiers: *Lake Erie, *Particulate fractions, *Microflora, Linear sucrose gradient, Beckman tube cutting device, Membranous organelles, Streptomyces, Micromonospora, Pseudomonads, Environmental contaminants, Biological reactions.

Water samples from a 15-foot depth of Lake Erie and from the surface of Sandusky River, Ohio, were subjected to gradient centrifuging. Different submicroscopic fractions of suspended particulates (mineral and detritus) were investigated by electron microscopy and examined for their ability to influence biological reactions. Addition of the particulate fraction 0.3 micron and larger to a carbon-free salts medium caused a significant increase in the biomass of Micromonospora and Streptomyces. An aggregation of submicroscopic particles of magnesium silicate with an exocellular polymer, produced by a floc-forming pseudomonad, was demonstrated. A system of ecological control of pollution involving a buildup of larger aggregates by association of inorganic particles and organisms is postulated. (Wilde-Wisconsin)
W70-03505

HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS,

Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.

H. Stefan, and F. R. Schieber.

ASCE National Water Resources Engr Meeting, Memphis, Tenn, Jan 26-30, 1970. Preprint, 39 p, 19 fig.

Descriptors: *Heated water, *Heat flow, *Impoundments, Lakes, Reservoirs, *Thermal pollution, Hydraulic models, Density currents, Stratified flow, Turbulence, Jets, Temperatures, Froude number, Thermal stratification.

The physical aspects of the flow of heated water from open channels into large, deep impoundments, such as lakes and reservoirs, are considered. The data were obtained in a number of laboratory experiments. Both the outlet channel and the receiving tank had rectangular cross-sections, but the tank was more than ten times wider and deeper than the channel. Measurement of local velocities proved to be difficult, and the tethered sphere was developed. Local temperatures were also measured and surface spreading patterns were recorded photographically. Densimetric Froude numbers and Reynolds numbers at the outlet ranged from 0.6 to 7.2 and from 1500 to 9600, respectively. Some results were presented graphically, but analysis was minimal. (Novotny-Vanderbilt)
W70-03540

THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR,

Bechtel Corp., San Francisco, Calif.

For primary bibliographic entry see Field 05D.

W70-03542

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,

Worcester Polytechnic Inst., Mass.

Leslie Hooper, and Lawrence Neale.

Journal Boston Society of Civil Engineering, Vol 44-45, p 356-365, 1957-1958.

Descriptors: *Model studies, *Hydraulic models, *Water cooling, Heat transfer, Temperature, Thermal powerplants.

Model tests are used to outline the nature of the difficulties involved when a relatively small river is called upon to supply the cooling water for a modern steam unit and to suggest any means of reducing the effects both upon the unit performance and the river. Considerations in the design of a model to study the density and temperature effects of the cooling water problem in a stream has been made. Reynolds number, distortion, density effects, temperature and heat transfer have been analyzed. The translation of the tem-

perature rise and heat transfer effects from the model to the prototype and the question whether any of the cold water that is being provided upstream in the river manages to get by the plant without bearing its full load of heat has been treated. Conclusions were: (a) The recommendations in the design of cooling water systems is that the plant should be located on the outside bank of a stream. (b) It is believed that a river model can be used to provide design information on the temperature increase that can be expected for various flow conditions in the river and circulating water demands of a steam powerplant. (Guerrero-Vanderbilt)

W70-03549

SC. Effects of Pollution

SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE, Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

Kenneth B. Cumming, and R. Don Estes.

Partly supported by Bur of Sport Fisheries and Wildlife. Available from the Clearinghouse as PB-189 170, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Center Bulletin 23, Virginia Polytechnic Institute, Sept 1969. 66 p, 16 fig, 3 tab, 17 ref, 11 append. OWRR Project No A-012-VA.

Descriptors: *Pumped storage, *Water temperature, *Thermal pollution, *Virginia, Stratification, Forebays, Water pollution control, Eutrophication, Environment, Aquatic habitats, Striped bass, Fisheries, Water quality, Water management (Applied), Regulation.

Identifiers: Roanoke River (Va).

A study was undertaken by the Virginia Cooperative Fishery Unit on the effects of the Smith Mountain pumped storage project. The study documents some of the before and after water quality features of the Roanoke River in the area of the pumped storage operation. Until now, there has been only a limited amount of data and little evaluation of the effects of such projects upon downstream water quality. While emphasis has been placed on water temperature regimes above, in, and below the project, there is considerable information on water chemistry and some of the operating dynamics which affect water quality. The research is of particular interest because downstream water quality could affect the resident striped bass population of Kerr Reservoir. There appears to be a trend toward deepening of the summer epilimnion since 1965. The schedule of water releases has substantially changed the flow pattern in the river without altering the average volume of discharged water. This variable flow has led to variable temperatures on a weekly basis and there is inferred a variable water chemistry because of the low flow during weekends. Temperature profiles are plotted and the data used to construct them are tabulated. (Knapp-USGS)

W70-03244

FISH AND POWER PLANTS,

New York State Dept. of Conservation, Albany. Div. of Marine and Coastal Resources.

Albert C. Jensen.

The Conservationist, New York State Conservation Department, Vol 24, No 3, p 2-5, Dec 1969-Jan 1970. 4 p, 2 fig, 2 photo.

Descriptors: *Hudson River, *Estuarine environment, *Pumped storage, Hydroelectric plants, Water temperature, Fish, Ecology, Aquatic habitats, Environmental effects, Fisheries, New York.

Identifiers: Hudson River Estuary, Storm King Mountain, Cornwall (NY).

A biological survey was made to predict the effects of the proposed Storm King Mountain pumped

storage hydroelectric plant on the ecology of the Hudson River Estuary. Large numbers of eggs, larvae, and young striped bass would be withdrawn by the proposed hydroelectric plant. However, the eggs and young fish that would be withdrawn would be but a small percentage of the total number of each of the life stages of striped bass present in the estuary. Approximately 2.8% would be subject to withdrawal. Substantial numbers of blueback herring, alewife, tomcod and white perch, small enough to pass through the screens, also would be withdrawn seasonally but that because of the varying distribution of the species in the estuary, the effect of losses by the operation of the plant probably would be minimal. Operation of additional plants-power, manufacturing or other—that require large volumes of water could, in combination with the proposed Cornwall plant, destroy sufficient numbers of eggs and larvae of fishes to adversely affect subsequent populations. These effects could be particularly severe if the plants were built in areas of heavy fish concentrations. The proposed pumped-storage hydroelectric plant at Cornwall would not have a significant adverse effect on the populations of striped bass and shad in the Hudson River. (Knapp-USGS)

W70-03250

STUDIES RELATING TO WATER MINERALIZATION AND HEALTH,

Bureau of Water Hygiene, Cincinnati, Ohio.

Elliott F. Winton, and Leland J. McCabe.

Journal of American Water Works Association, Vol 62, No 1, p 26-30, Jan 1970. 5 p, 2 fig, 4 tab, 36 ref.

Descriptors: *Water quality, *Public health, *Human diseases, *Human pathology, *Hardness (Water), Mortality, Trace elements, Calcium, Magnesium, Chemical properties, Water softening.

Identifiers: Heart disease-water quality relations.

Recent studies on the relation of heart disease to water quality are reviewed. Correlation is sufficient to suggest more definitive studies to resolve the question. Calcium, magnesium, and total hardness contents of drinking water seem to be inversely correlated with coronary heart disease death rates in England, the United States, and Asian countries. Several specific questions are listed for experimental and statistical investigation. (Knapp-USGS)

W70-03252

A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,

Geological Survey, Tallahassee, Fla.

Darwin Knochenmus.

Geol Surv Open-file Report, Sept 1969. 10 p, 1 fig, 1 tab.

Descriptors: *Water quality, *Lakes, *Eutrophication, *Florida, Aquatic productivity, Water pollution sources, Septic tanks, Storm drains, Nutrients, Urbanization, Storm runoff.

Identifiers: Eustis (Fla), Crooked Lake, Lake Dicie.

A study was made of 2 lakes near Eustis, Florida to determine the cause of algal blooms in one of them while the other had no blooms. Lake Dicie is smaller, shallower, and thus at times probably warmer than West Crooked Lake. Significant land use differences in their drainage basins exist; private dwellings serviced by septic tanks comprise 50% of the drainage area of Lake Dicie as compared to only 20% of the drainage area of West Crooked Lake. The ratio of drainage area to lake surface is approximately 24:1 for Lake Dicie (after installation of a storm drain) whereas the ratio is only 10:1 for West Crooked Lake. The higher concentration of nutrients in Lake Dicie seems to be related to the larger drainage area ratio and the increase in nutrient and water inflow through the storm drain, as well as to the many septic tanks in the Lake Dicie drainage basin. Many other small lakes and ponds in Lake County which receive street drainage have algal blooms. (Knapp-USGS)

W70-03260

ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM,

Washington Univ., Seattle. Dept. of Zoology.

John G. Stockner.

Journal Fisheries Research Board of Canada, Vol 25, No 10, p 2037-2058, 1968. 13 fig, 7 tab, 25 ref.

Descriptors: *Primary productivity, *Algae, *Thermal water, Periphyton, Biomass, Physiological ecology, Cyanophyta, Diffusion, Respiration, Phosphates, Ecosystems, Organic matter, Water pollution, Thermal pollution, Streams, Nutrients, Light, Washington, Water chemistry, Oxygen, Hydrogen ion concentration, Photosynthesis, Alkalinity, Nitrates, Conductivity, Chlorides, Carbonates, Sulfates, Bicarbonates, Potassium, Iron, Sodium, Calcium, Magnesium, Phosphorus.

Identifiers: *Algal growth, *Thermobiology, *Diurnal oxygen curves, Calorimetry, Solarimetry, Yellowstone National Park, Mt Lassen National Park, Mt Rainier National Park, Ohanapecosh Hot Springs (Wash), Schizothrix, Phormidium, Winkler technique, Oxygen electrodes, Atomic absorption spectrophotometry, Total dissolved solids, Hedriodiscus, Caloparyphus.

Trophic relationships in flowing water are not as well understood as those in more static environments. Because of their relatively constant conditions, streams draining thermal springs are ideal sites for such studies. Estimates of primary production and respiration of blue-green algae in stream draining one of the Ohanapecosh Hot Springs, Washington, were obtained throughout 1966 from daily oxygen curves. Rates of gross primary productivity were slightly higher than published values from other aquatic ecosystems, but were less than recent estimates, derived from measurement of radiocarbon uptake from other thermal waters. Calculated ratios, production/respiration, were in range 1.1-5.0. As growing season progressed, photosynthetic effects on ionic composition of effluent water, as well as morphological changes in algal mat, were observable. Changes in algal biomass during 1964-1965, together with growth rates in denuded areas by two methods of harvest were studied. Accelerated growth occurred in May and June, associated with maximal values for primary production, whereas growth was minimal in winter. Significant differences in growth between years were attributed to differences in harvesting methods, and to production of auto-inhibitory toxins by senescent cells in mature mat. Annual energy budget for mat is derived from 1966 estimates. (Eichhorn-Wisconsin)

W70-03309

CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE,

Wisconsin Univ., Madison. Dept. of Botany.

For primary bibliographic entry see Field 05G.

W70-03310

A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR,

Minnesota Univ., Minneapolis. School of Public Health.

For primary bibliographic entry see Field 02H.

W70-03311

MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES ON LAGOON ECOLOGY,

North Dakota Univ., Grand Forks. School of Medicine.

John W. Vennes.

Available from the Clearinghouse as PB-189 159, \$3.00 in paper copy \$0.65 in microfiche. Completion Report, Aug 1969. 82 p, 3 fig, 41 tab, 35 ref. OWRR Project No A-016-NDAK.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Descriptors: *Microbiology, *Sewage lagoons, *Industrial wastes, Sewage treatment, North Dakota, Coliforms, Oxidation lagoons, Biochemical oxygen demand, Photosynthesis, Hydrogen sulfide, Lakes, Algae, Enteric bacteria, Methane bacteria, Chemical analysis, Water pollution, Chlorella, Scenedesmus.

Identifiers: *Microbial ecology, Purple sulfur bacteria, Population equivalents (Wastes), Red River Valley (North Dakota), Sulfate reduction, Potato processing wastes, Cheese manufacturing wastes, Starch manufacturing wastes, Water quality standards, Grafton (ND), Lakota (ND), Harvey (ND), Chromatium vinosum, Thiocapsa floridana, Enterococci, Park River (ND), Sheyenne River (ND), Thiopedia.

State and federal legislation, regulating effluent discharge to natural waters, is such that food processing industries in North Dakota must discharge wastes into municipal lagoons resulting in frequent overloads of these systems. Lagoon at Grafton, designed for 5-day biochemical oxygen demand (BOD-5) of 30 pounds/acre per day, receives 240, largely from two potato processing plants. Increased loadings favor (as dominant microorganisms in these lagoons) the purple sulfur bacteria (PSB), which photosynthetically utilize hydrogen sulfide and various volatile organic acids for growth. Most reduction in BOD-5 at Grafton is attributable to three genera of PSB: Chromatium, Thiopedia, Thiocapsa. Increased loading does not significantly multiply numbers of enteric organisms here. A natural lake, used for sewage stabilization in Lakota, receives whey; it recovers to an algal phase during summer, and shows no increase in numbers of enteric organisms. At Harvey, an aerated continuous discharge lagoon, receiving domestic wastes and intermittent creamy wastes, reduces BOD-5 to near stream levels, but cannot reduce coliforms to acceptable numbers. If the latter treatment is to succeed in northern climates, consideration must be given to longer detention times, greater delivery of oxygen to cells, chlorination, or reevaluation of stream standards. (Eichhorn-Wisconsin)

W70-03312

EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH,

Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Sandy Hook Marine Lab.

Ronald Eisler, and Philip H. Edmunds.

Transactions of the American Fisheries Society, Vol 95, No 2, p 153-159, April 1966. 4 fig, 5 tab, 28 ref.

Descriptors: *Chemistry, *Marine fish, *Endrin, Insecticides, Temperature, Salinity, Hydrogen ion concentration, Mortality, Colorimetry, Spectroscopy, Sodium, Potassium, Calcium, Chlorides, Ureas, Magnesium, New Jersey, Weight, Length, Eels, Killifishes, Mullets, Silversides, Guts, Proteins.

Identifiers: *Blood, *Tissue, Puffers, Sphaeroides maculatus, Hemoglobin, Liver, Serum, Cholesterol, Gamma-globulin, Zinc, Gill tissue, Sandy Hook Bay (NJ), Anguilla rostrata, Fundulus heteroclitus, Fundulus majalis, Pomatomus saltatrix, Pseudopleuronectes americanus, Mugil cephalus, Syngnathus fuscus, Oral membrane, Kidneys, Menidia menidia.

Adult northern puffers, Sphaeroides maculatus, were exposed to graded concentrations of endrin, a chlorinated hydrocarbon insecticide, at 20C, 24 parts/thousand salinity and pH 8.0. All animals subjected to 10.0 parts per billion (ppb) of endrin died within 24 hours. At concentrations of 1.0 ppb of endrin, or lower, no mortality occurred within 96 hours. Blood and tissue samples from fish surviving the 96-hour exposure were analyzed by photoelectric colorimetry and atomic absorption spectroscopy. Mean hemoglobin content and relative liver size of puffers exposed to endrin concentrations of 1.0, 0.5, 0.1, or 0.05 ppb did not significantly differ from controls. Although no meaningful changes in serum chloride levels, gamma globulin, and uric acid were found, concentrations of sodium, potassium, calcium, and cholesterol in serum were consistently higher in experimental animals than controls. Concentrations of sodium, potassium, calcium, magnesium, and zinc in livers of test animals were consistently lower. Concentrations of same cations in gill tissue fluctuated widely. Exposure to sublethal concentrations of endrin impaired liver functions, evidenced by transfer of major cations from hepatic tissue into serum and by elevated serum cholesterol. (Jones-Wisconsin)

W70-03314

COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES,

Toronto Univ (Ontario). Dept. of Zoology; and Fisheries Research Board of Canada, Winnipeg (Manitoba).

For primary bibliographic entry see Field 02H.
W70-03315

LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET,

Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-03322

A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS,

Oregon State Univ., Corvallis. Dept. of Botany. C. David McIntire, and Barry L. Wulff. Limnology and Oceanography, Vol 14, No 5, p 667-678, 1969. 6 fig, 4 tab, 20 ref.

Descriptors: *Marine algae, *Diatoms, *Benthic flora, Light intensity, Biomass, Distribution, Ecosystems, Population, Oregon, Intertidal areas, Physiological ecology, Littoral, Estuaries, Photosynthesis, Respiration, Pigments, Chlorophyll, Temperature, Oxygen, Salinity.

Identifiers: Desiccation, Yaquina Bay (Ore), Carotenoids, Species, Diversity index, Achnanthes, Actinopyctus, Amphipleura rutilans, Amphora, Aulacodiscus, Bacillaria, Biddulphia, Chaetoceros, Cocconeis, Coscinodiscus, Dimerogramma, Diploneis, Eunotogramma, Fragilaria, Gomphonema, Gyrosigma, Melosira, Navicula, Nitzschia, Skeletonema, Plagiogramma, Pleurosigma, Rhaphoneis, Rhoicosphenia, Surirella, Synedra.

Effects of light intensity and exposure to desiccation on vertical distribution and growth of marine benthic diatom populations were investigated in a laboratory model ecosystem and respirometer chamber. Diatom flora developed was similar to that from field stations in lower Yaquina Bay, Oregon. Vertical distribution of many species was closely related to light intensity and period of exposure to desiccation. Biomass accumulated rapidly on substrates subjected to high light intensities without exposure to desiccation. Communities acclimated to various light intensities and period of desiccation responded differently to changes in light intensity in respirometer chamber. Experimental results show that laboratory apparatus described can be useful in study of simplified intertidal communities. System provides some laboratory control over salinity, light intensity, tidal cycle, and probably temperature. Movements and grazing activities of small marine invertebrates could be studied. It is emphasized that use of such laboratory ecosystems is subject to certain limitations resulting from simplifications of nature. Laboratory ecosystems are best used to gain information to supplement and help understand concurrent observations in the field. (Jones-Wisconsin)

W70-03325

TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION,

Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Sandy Hook Marine Lab.
Ronald Eisler.

Bureau of Sport Fisheries and Wildlife, Wash, DC, Technical Paper 17, Sept 1967. 15 p, 6 fig, 6 tab, 37 ref.

Descriptors: *Insecticides, *Marine fish, Mortality, Sodium, Potassium, Calcium, Magnesium, Iron, Enzymes, Estuarine environment, NJ, Temperature, Spectrophotometry, Gonads, Length, Weight, Proteins, Electrophoresis, Salinity, Hydrogen ion concentration, Crustaceans.

Identifiers: *Tissue changes, *Puffers, *Methoxychlor, *Methyl parathion, Blood, Serum, Zinc, Liver, Gills, Biocides, Sandy Hook Bay (New Jersey), Muscle, Gill arch, Densitometric, Starvation, Biochemical profiles, Hemoglobin, Hematocrit, Erythrocyte.

Puffers were exposed to either 30 parts per billion (ppb) methoxychlor, 20,200 ppb methyl parathion, or a combination of 15 ppb of methoxychlor and 10,100 ppb of methyl parathion. These concentrations produced approximately 5% mortality in 96 hours under experimental conditions. Tissues from each group were analyzed for blood and serum constituents and for sodium, potassium, calcium, magnesium, zinc, and iron. Puffers in 30 ppb methoxychlor remained active as controls, ate readily, and experienced no significant mortality. No statistically significant differences at 0.01 level were observed between methoxychlor-exposed puffers and controls for parameters investigated. Groups exposed to methyl parathion alone, or to methyl parathion in combination with methoxychlor, refused to eat, were sluggish, and after 96 hours, exhibited a rapid increase in mortality. Survivors, compared to controls, had less hemoglobin, erythrocytes, lower hematocrit, inhibition of serum esterase enzymes, less magnesium in liver, and less zinc in liver and gill filaments; differences were significant at 0.01 level. Profiles were based on effects of each insecticide on blood and tissues. Visual patterns provided by profiles suggest means of identifying unfavorable environmental conditions before appearance of obvious morphological or physiological changes. (Jones-Wisconsin)

W70-03326

LABORATORY STUDIES OF PERIPHYTON PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS,

Oregon State Univ., Corvallis. Pacific Cooperative Water Pollution and Fisheries Research Labs.

C. David McIntire, and Harry K. Phinney. Ecological Monographs, Vol 35, No 3, p 237-258, Summer 1965. 15 fig, 12 tab, 54 ref.

Descriptors: *Periphyton, *Productivity, *Metabolism, *Lotic environment, Ecosystems, Primary productivity, Energy, Respiration, Light intensity, Temperature, Carbon dioxide, Seasonal, Biomass, Organic matter, Chlorophyll, Export, Dissolved oxygen, Photosynthesis, Hydrogen ion concentration, Bicarbonates, Alkalinity, Diatoms, Cyanophyta, Chlorophyta, Molecular structure, Chemical analysis, Oxygen, Turbidity, Copepods, Oligochaetes, Natural streams, Dissolved solids.

Identifiers: Community, Carotenoids, Total solids, Particulate, Phormidium retzii, Syndra ulna, Oedogonium, Light-adapted, Shade-adapted, Ulothrix, Melosira varians, Cymbella, Epithemia, Navicula, Anabaena, Tendipes, Calopsestra, Polypodium, Brilla, Baezia, Callibactis, Paraleptophlebia, Ameletus, Cinygmulia, Epcorus, Compensation point.

Studies of periphyton production and community metabolism in lotic environments were made in laboratory streams and with a photosynthesis-respiration chamber. Curves related illumination intensity to primary production in 'light-adapted' and 'shade-adapted' periphyton communities. In the former, primary production was continuously enhanced at illumination intensities exceeding 1000-foot-candles by increasing molecular carbon dioxide supply to a concentration of 45 milligrams/liter; no significant enhancement occurred in shade-adapted community. Gross production in laboratory streams was slightly greater than normally reported for eutrophic lakes and oceanic

Effects of Pollution—Group 5C

waters and more characteristic of the least-productive flowing water systems, within the value range for natural environments at similar periods. Efficiency of fixation of usable light energy as organic matter was 15.1% in the light-grown community and 18.3% in the shade-grown. Laboratory community efficiencies were higher than estimated for most natural ecosystems. Chlorophyll a content was well within the range of values reported for several types of natural communities. Laboratory gross primary production-chlorophyll a ratios varied from 0.2 to 1.4 milligrams oxygen/hour per milligram chlorophyll a. The community, under higher light intensity, was reasonably stable by end of third month; shadegrown community succession was slower. (Jones-Wisconsin)
W70-03327

CHIRONOMIDA AND THE STUDY OF LAKE TYPES,

For primary bibliographic entry see Field 02H.

W70-03322

ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES,

Wisconsin Univ., Madison. Dept. of Entomology.

For primary bibliographic entry see Field 02H.

W70-03333

ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE,

Scripps Institution of Oceanography, La Jolla, Calif.

Osmund Holm-Hansen.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ., Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 98-108. 37 ref.

Descriptors: *Algae, *Nutrient requirements, *Environmental effects, Biomass, Phytoplankton, Zooplankton, Red tide, Vitamins, Carbon, Hydrogen, Oxygen, Nitrogen, Sulfur, Phosphorus, Potassium, Magnesium, Calcium, Iron, Boron, Copper, Molybdenum, Cobalt, Manganese, Sodium, Chlorine, Productivity, Eutrophication, Photosynthesis, Time, Dissolved solids, Cyanophyceae, Sewage effluents, Ions, Chemical properties, Enzymes, Light intensity, Temperature, Carbohydrates, Lipids, Diatoms, Oceans, Physiological ecology.

Identifiers: Ciliate, Photoautotrophic, Endosymbiotic, Growth factors, Vanadium, Macronutrient, Micronutrient, Zinc, Silicon, Bromide, Iodine, Adenosine triphosphate, Selenastrum, Particulate fraction, Algal strains, Euphotic zone, Morphology, Cytology.

Adenosine triphosphate, in a sensitive analytical method, is useful in estimating total biomass. Essential macronutrient elements are: carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorus, potassium, magnesium, and calcium. Essential micronutrient elements are: iron, boron, zinc, copper, molybdenum, manganese, cobalt, sodium, and chlorine. Many diatoms need silicon for growth; whether vanadium, bromine, and iodine are sometimes essential is unknown. The only known organic nutrients important for various algae, are vitamins B-1, B-12, and biotin. In productivity studies of natural waters and eutrophication, the potential capacity of water to support phytoplankton should be known; also which element(s) is limiting to algal growth. Data from enrichment experiments are analyzed. Bottle tests with selected algal strains indicate by productivity, carrying capacity of water. This 'growth potential' serves as a guideline in eutrophication problems and sewage treatment. Physiological adaptation of species to environment is significant; nutrient deficiency is expected to alter cell chemical composition or enzymatic activity, or concentration. Open-system chemostat techniques make possible deter-

mination of substrate concentration permitting maximum growth and prediction of productive capacity of species for different water masses. Heterotrophy, or uptake of organic solutes by plant cells, is significant. (See Vol. 3, No. 7, Field 5C, W70-02775). (Jones-Wisconsin)
W70-03335

PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROTROPHY IN ALGAL FLAGELLATES: CONDITIONALLY EXPRESSED CHARACTERISTICS,

California State Coll., Hayward. Dept. of Biological and Health Sciences.

Stanley Scher.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ., Berkely, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 117-140. 4 fig, 9 tab, 85 ref.

Descriptors: *Physiological ecology, *Algae, *Biological properties, Organic compounds, Nutrition, Photosynthesis, Environmental effects, Metabolism, Enzymes, Cytological studies, Eutrophication, Chlamydomonas, Dinoflagellates, Ochromonas, Carbohydrates, Amino acids, Hydrogen ion concentration, Chelation, Inhibition, Carbon radioisotopes, Water pollution effects, Vitamins.

Identifiers: *Heterotrophy, *Flagellates, *Regulatory biology, Thermobiology, Photobiology, Cytotechnology, Algal growth, Carbon sources, Nitrogen sources, Buffers, Biosynthesis, Metabolites, Euglena gracilis, Eucaryotes, Chlamydomobrys, Photoautotrophy, Dissolved organic matter, Phosphorus sources, Analog compounds, Radiocarbon uptake technique, Repression, Chloroplasts, Cellular organelles, Mitochondria, Auxotrophy.

Evidence mounts of utilization, by photoautotrophic algae for growth, of various exogenous organic compounds of low molecular weight dissolved in the hydrosphere. Such heterotrophy may take various forms: organic compounds may serve as intracellular carbon, nitrogen, and phosphorus sources; as hydrogen donors for carbon dioxide fixation or nitrite reduction; or as buffers and chelators. Utilizable carbon and nitrogen sources probably serve to control cellular growth and reproduction by repression of the synthesis of inducible enzymes, or by feedback inhibition of enzymes operating in biosynthetic pathways. Recent evidence suggests that such controls may operate directly on algal chloroplasts and mitochondria.

Because heterotrophy may be influenced by environmental characteristics, such as non-optimal pH or supraoptimal temperature, it has been termed latent or conditionally-expressed auxotrophy. Information on heterotrophy is illustrated with evidence accumulated from study of various strains of the green alga, Euglena. Large and varied fractions of dissolved organic matter found in eutrophic waters suggest that heterotrophic phenomena may be important. Changes away from optimal conditions may limit population growth of eucaryotes via emergence of auxotrophy or failure of photosynthetic mechanisms, or community structure may be changed because of competition of algae with heterotrophic bacteria. (See Vol 3, No 7, Field 5C, W70-02775). (Eichhorn-Wisconsin)
W70-03336

LAKE MICHIGAN BEACH SURVEY 1968.

Illinois State Sanitary Water Board, Springfield.

Illinois State Sanitary Water Board, Report to 76th General Assembly, Feb 1969. 40 p, 3 ref, 7 tab, 18 fig.

Descriptors: *Water quality, *Lake Michigan, *Illinois, *Water pollution, *Beaches, Recreational facilities, Bacteria, Coliforms, Water pollution sources, Phosphates, Surfactants, Ammonia,

Hydrogen ion concentration, Phenols, Thermal pollution.

Identifiers: Lake County, Cook County, Waukegan (Ill), Chicago.

The 1968 Sanitary Water Board monitoring program indicated that portions of Lake Michigan inshore waters failed in many cases to meet water quality criteria. Shore water on Illinois beaches frequently failed to meet bacteria criteria. Unacceptably high bacterial counts were typical of Lake County beaches and Cook County beaches near major recreational boat harbors. All beaches failed to meet criteria for phosphates and surfactants (MBAS). Concentrations of ammonia nitrogen increases in a northerly direction. Two-thirds of Lake County beaches failed to meet ammonia criteria while only two of nineteen failed to meet the criteria in Cook County. All beaches met the requirements for temperature, phenol-like substances, cyanides (with one sample exception) and pH (also with a single sample exception). The discharge of polluted water into Lake Michigan from the Chicago area, as the result of a severe rainstorm on 16 August 1968, did not significantly lower the bacterial quality of the Chicago beaches, with the exception of a two-day effect on beaches near the mouths of the Chicago and Calumet rivers. The beaches of the lowest quality were those in Lake County. This was largely a result of the overloaded Waukegan sewage treatment plant, the industrial waste effluent discharges, and the effluent from the five small primary sewage treatment plants operated by the North Shore Sanitary District. (Davis-Chicago)
W70-03339

CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.

Federal Water Pollution Control Administration, Edison, N.J. Northeast Region Research and Development Program.

Available from the Clearinghouse as PB-189 172, \$3.00 in paper copy, \$0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-27, Aug 1969. 22 p, 3 tab, 19 fig, 7 ref. FWPCA Program 15080 FHS 08/69.

Descriptors: Beach, *Cleaning, Detergent, *Emulsifier, Erosion, Oil, *Oil wastes, Water pollution, Quicksand, Sand.

Oil-dispersing chemicals were treated for cleaning persistent-type crude oil from experimentally contaminated New Jersey coastal beaches and were found to be generally ineffective. Although they completely cleaned the surface of the oiled sand, they removed little of the total oil. Instead they caused the oil to penetrate more deeply into the underlying sand, thereby compounding the pollution problem by expanding the zone of pollution, complicating any subsequent mechanical removal and, possibly, causing the oil to persist longer. Chemical treatment failed to induce 'quicksand' or cause perceptible erosion of beach sand. A decrease in the 'cohesiveness' of the sand was observed, but this also occurred in the presence of oil alone and could not be attributed to the presence of chemical.
W70-03349

BIOLOGICAL N₂ FIXATION IN LAKES, Wisconsin Univ., Madison. Water Resources Center.

Robert H. Burris.

Available from the Clearinghouse as PB-189 163, \$3.00 in paper copy, \$0.65 in microfiche. Wisconsin Water Resources Center, Technical Report OWRR B-020-Wis, 1969. 6 p. OWRR Project B-020-WIS.

Descriptors: *Nitrogen-fixation, *Nutrients, *Lakes, *Algae, *Nitrogen, Wisconsin.

Identifiers: *Analytical methods, *Biochemistry methods, Seasons, Acetylene reduction test.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Acetylene reduction by nitrogen-fixing organisms was used to estimate potential nitrogen fixation by blue-green algae in lakes. The method gives a useful index of nitrogen fixation with regard to the role of nitrogen-fixing agents in the eutrophication process. Lake Mendota (eutrophic), Madison, Crystal and Trout Lakes (oligotrophic), Vilas County, Wisconsin, and Little Arbor Vitae Lake (eutrophic) Vilas County, Wisconsin, were sampled at points 100 feet from shore and at mid-lake during the summer of 1968. Analyses of samples indicated that acetylene reduction varies drastically among lakes in a given area (Little Arbor Vitae Lake fixed 125-380 nanomoles C sub 2 H sub 4 N/30 minutes to less than one nanomole for Trout Lake on July 28, 1968), and varies markedly with time in a specific lake (for Little Arbor Vitae Lake, when samples were collected on September 10, 1969, the acetylene reduction per liter of water or per mg N had decreased 10 to 20 fold from those of July 28, 1968). Acetylene reduction in lakes was studied with respect to changes in season, presence of natural-occurring algae (*Gloeotrichia* colonies chiefly), variation in depths, and difference in light. Samples taken from Green Bay, Wisconsin were also analysed. (Kerrigan-Wisconsin)
W70-03429

A NEW POLLUTION PROBLEM,
Committee for Environmental Information, St. Louis, Mo.
For primary bibliographic entry see Field 05B.
W70-03456

OCCURRENCE AND QUALITY OF GROUND-WATER IN SHACKELFORD COUNTY, TEXAS,
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 02F.
W70-03460

CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE,
Eastern New Mexico Univ., Portales. Dept. of Biological Sciences.
For primary bibliographic entry see Field 05B.
W70-03501

PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA,
Ohio State Univ., Columbus. Dept. of Microbiology; and Ohio State Univ., Columbus. Aquatic Biology Lab.
For primary bibliographic entry see Field 05B.
W70-03505

THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,
Wisconsin Univ., Madison. Dept. of Botany.
Gerald C. Gerloff, George P. Fitzgerald, and Folke Skoog.
American Journal of Botany, Vol 39, p 26-32, 1952. 7 tab, 8 ref.

Descriptors: *Algae, *Nutrients, *Nutrient requirements, Growth rates, Laboratory tests, Cultures, Sodium compounds, Nitrogen.
Identifiers: *Microcystis aeruginosa (Kutz), Culture media, Chu No 10 solution, Minimum nutrients.

A *Microcystis aeruginosa* (Kutz) culture was made axenic by ultraviolet light and grown in basal medium of Chu No 10 solution, modified so that cations were furnished as chloride salts, and anion as the sodium salts. Minimum elemental requirements for optimum growth yield was determined by use of this medium. Small amounts of sodium were reported to be essential for the growth of *Microcystis* but a beneficial effect of either sodium carbonate or sodium silicate was found to be due primarily to pH control. *Microcystis* exhibited an optimum growth at pH of approximately 10; at this pH, sodium nitrate, sodium nitrite or ammonium chloride

were equally effective nitrogen sources. When minimum nutrient concentrations were determined each in turn, a new medium composed of these concentrations was found to support maximum yields as compared to the slightly modified Chu No 10 medium. Composition of this medium, in milligrams/liter, was: nitrogen 13.6; phosphorus 0.18; sulfur 0.83; potassium 1.13; magnesium 0.13; calcium 0.25; iron 0.06; and the 'usual' amounts of sodium carbonate and sodium silicate. Disadvantages of this medium for routine use were that growth lag, pale cells, and requirements for a 'larger' inoculum was exhibited. (Gerhold-Wisconsin)
W70-03507

I. PRODUCTIVITY: PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA, California Univ., Davis. Dept. of Zoology.

Charles R. Goldman, and Richard Armstrong.
Verh Internat Verein Limnol, Vol 17, p 49-71, Nov 1969. 21 fig, 3 tab, 9 ref.

Descriptors: *California, Nevada, Eutrophication, Oligotrophy, Littoral, Periphyton, Diatoms, Fungi, Streams, Carbon radioisotopes, Temperature, Light intensity, Calcium, Magnesium, Sodium, Potassium, Spectrophotometry, Nitrogen, Ammonia, Photosynthesis, Phosphates, Nitrates, Growth rates, Depth, Distance, Areal, Sampling, Surface waters, Runoff, Ultraviolet radiation.

Identifiers: *Lake Tahoe (Calif), *Gomphonema constrictum*, *Apostemidium guernsiae*, Homewood (Calif), *Fragilaria crotonensis*, Organic growth factors, Chelation.

Lake Tahoe's enrichment and areal variability in productivity influenced by tributary streams have been investigated. Knowledge of factors causing higher production rates in certain areas should enhance evaluation of nutrients in entire lake and assist in effectively slowing eutrophication. Productivity measurements at the mouths of streams showed dispersion of stream-borne nutrients influencing primary productivity. Calculating relative photosynthetic efficiencies provided best comparisons of areal variability. Relative influence of tributary waters of three streams was assessed; water from unpolluted control stream did not provoke the response as the others. Although importance of nitrogen or phosphorus was implied, stream water appeared more stimulating than its nitrogen and phosphorus content alone implied, perhaps affected by organic growth factors or natural chelating agents. Each stream bioassay was accompanied with a productivity experiment at the stream's mouth in the lake. Stimulation of photosynthesis by stream water was seasonal. Water was analyzed for calcium, magnesium, sodium, potassium and ultraviolet absorbance. Absorbance was greater in streams than lake and offered greater promise of being a water-mass indicator; its measurements in water samples, compared with productivity data, showed relationship restricted to waters around the Upper Truckee River mouth. (Jones-Wisconsin)
W70-03508

PRESIDENT'S LECTURE: LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-03509

EDGARDO BALDI MEMORIAL LECTURE: CURRENT CONCEPTS IN AQUATIC MICROBIOLOGY,
Woods Hole Oceanographic Institution, Mass.
Holger W. Jannasch.
Verh Internat Verein Limnol, Vol 17, p 25-39, Nov 1969. 5 fig, 61 ref.

Descriptors: *Aquatic microbiology, Limnology, Enzymes, Carbon radioisotopes, Bicarbonates, Bacteria, Biomass, Respiration, Degradation (Decomposition), Hypolimnion, Sulfides, Eutrophication, Nitrification, Photosynthetic bac-

teria, Pigments, Productivity, Physiological ecology, Metabolism, Bioassay, Benthic flora, Gas chromatography, Ecology, Biochemistry.

Identifiers: Uptake rate, Substrate concentration, Adenosine triphosphate, Nucleic acids, Black Sea, Autotrophic, Heterotrophic, Light absorption, Carotenoids, *Bdellovibrio*, Morphology, Autoradiography, Thymidine, Chemostat, Autochthonous, Steady state, Zymogenous, Suspended particles, Halophilism, Psychrophilisms, Physiology.

Ecological niches, such as sulfide-containing hypolimnia, are highly selective habitats for some specific microbial metabolic types. This area requires microbiological studies based on clear ecological concepts. In analytical approach to natural microbial populations, use of a pure bacterium culture was suggested as a 'bioassay' procedure. Where gas chromatography, atomic absorption, or enzymatic techniques fail, the bioassay may be useful. One problem in aquatic microbiology is assessing growth or metabolic transformations at minute concentrations of energy sources or essential nutrients. Advantage of determination of incorporation of labelled thymidine into cells by autoradiography lies in its specificity compared to the relatively unspecific dark uptake of labelled bicarbonate. Not until discovery that a homogeneously mixed continuous culture of an exponentially growing microorganism represents a self-adjusting system (chemostat) did continuous culture technique become invaluable in quantitative studies. While classical enrichment techniques are limited to microbial species of substrate specificity, the selective properties of the chemostat have been used for enrichments and isolations of some inconspicuous metabolic types. An aspect of microbial ecology is two species establishing a steady state, one dependent on growth limiting factor, the other controlled by metabolic products of the first. (Jones-Wisconsin)
W70-03510

NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA,
Pittsburgh Univ., Pa. Dept. of Biological Sciences. Vera A. Dugdale, and Richard C. Dugdale.
Limnology and Oceanography, Vol 7, p 170-177, 1962. 3 fig, 4 tab, 14 ref.

Descriptors: *Nitrogen fixation, *Lakes, *Eutrophication, Nitrates, Ammonia, Phosphates, Sewage, Photosynthesis, Pennsylvania.
Identifiers: Nitrogen budget, Nitrogen-15, Anabaena, Sanctuary Lake (Pa).

Using nitrogen-15, high rates of nitrogen fixation were demonstrated in Sanctuary Lake, Pennsylvania. The fixation was related to light, and therefore probably to photosynthesis. Significant fixation rates were found first in early June and rates of at least 1% per day prevailed until September. There was a correlation between the appearance of *Anabaena* in the spring and nitrogen fixation rates and the implication is that these organisms are probably the important primary fixers. Rates of nitrogen fixation were highest when the ammonium and nitrate concentrations were minimal. Another factor of possible importance in determining the nitrogen fixation rates in this lake is the input of raw sewage from an adjacent town. (Keeney-Wisconsin)
W70-03511

THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT,
Federal Water Pollution Control Administration, Corvallis, Ore. Pacific Northwest Water Lab. Robert M. Brice, and Charles F. Powers.
Proceedings of the Eutrophication-Bioturbation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore. Pac Northwest Water Lab, p 258-269. 5 fig, 4 tab.

Effects of Pollution—Group 5C

Descriptors: *Minnesota; *Eutrophication, Sewage effluents, Tertiary treatment, Algae, Water quality, Coniferous forests, Deciduous forests, Phosphorus, Nitrogen, Cyanophyta, Chlorophyta, Diatoms, Weight, Pilot plants, Iron, Chlorella, Sodium, Potassium, Silicates, Dissolved solids, Calcium, Productivity, Standing crop, Chlorophyll, Phosphates, Additives.

Identifiers: *Shagawa Lake (Minn), Ely (Minn), Blooms, Chlorella pyrenoidosa, Microcystis aeruginosa, Burntside River (Minn).

This project sought to determine whether Shagawa Lake would recover from its presently advanced state of eutrophication if secondary sewage effluent presently entering the lake were changed to nutrient-stripped tertiary. Although data are incomplete and conclusions preliminary, studies showed lake water containing 5% secondary sewage effluent had appreciably higher algal productivity than Shagawa Lake water only or water containing 5% tertiary sewage effluent, the latter addition making no appreciable difference in the lake water. Burntside River water (80% surface inflow) containing 2% secondary sewage effluent had appreciably higher algal productivity than corresponding mixtures containing tertiary effluent. Further testing of Shagawa Lake water and Burntside River is continuing, using other concentrations of additives to explore more completely the biostimulation achieved through sewage fertilization. Additionally, experiments will be carried out in which various concentrations of nitrogen and phosphorus are added to Burntside River water, to determine whether either or both elements act to limit algal production. Anticipated results of these experiments will provide information necessary to decisions on future management policies for Shagawa Lake. (See Vol. 3, No. 7, Field 5C, W70-02775). (Jones-Wisconsin)
W70-03512

THE EFFECTS OF OIL-SPILL REMOVERS ('DETERGENTS') ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY,

Marine Biological Association of the United Kingdom, Plymouth (England). Lab.

G. W. Bryan.

Journal of the Marine Biology Association, U.K., Vol 49, p 1067-1092, 1969. 8 fig, 4 tab, 11 ref.

Descriptors: *Detergents, *Oily water, *Water pollution effects, Water pollution treatment, *Animal populations, Mortality, Food abundance, Resistance, Toxicity, Bioassay, Growth rates, Persistence, Migration.

Identifiers: *Torrey Canyon, *Nucella lapillus, *Growth disturbances, *Shell growth, Recolonization, Intertidal animals, BP 1002.

The effects of oil-spill removers ('detergents') on a population of *Nucella lapillus* was studied at Porthleven in South Cornwall, where heavy oil pollution occurred following the Torrey Canyon incident in March 1967. At Porthleven the species was wiped out in the harbour and the majority of animals were killed on the reef nearby. Growing animals which recovered from the effects of the 'detergent' were later found to have developed growth disturbances in the shell. These effects on growth appear to be an indirect effect of 'detergent' resulting from its interference with the ability of the animal to feed and with the availability of food. Recolonization of the reef depended largely on the survival of some very young animals in the sublittoral zone. Most of the potential predators had been wiped out by the 'detergent', these animals were able to invade the reef in large numbers late in 1967. In contrast, recolonization of the outer harbour, where the species was wiped out, was slow during the first 2 years and dependent on lateral movements of animals from the reef. (Sjolseth-Washington)
W70-03513

REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SUBLETHAL CONCENTRATIONS OF DDT,

New Hampshire Univ., Durham. Dept. of Zoology. Kenneth J. Macek.

Journal Fisheries Research Board of Canada, Vol 25, No 9, p 1787-1796, 1968. 1 fig, 4 tab, 17 ref. OWRR Project B-001-NH.

Descriptors: *DDT, *Fish reproduction, *Viability, *Pesticide toxicity, Brook trout, Chlorinated hydrocarbon pesticides, Mode of action fish eggs, Mortality, Pesticide residues, Gas chromatography, Growth rates.

Identifiers: *Gametes, *Sublethal effects, Chronic exposure, Sac fry.

Groups of sexually maturing yearling brook trout were fed for 156 days with DDT at .05 mg/kg per week (control, and 0.5, 1.0 and 2 mg/kg per week. The DDT caused no mortality and fish fed at the lower dosages produced more mature ova than untreated fish. The size of the male fish at the end of the feeded period was observed to increase according to the dosage of DDT. Egg and sac fry mortality was higher when at least one of the gametes came from treated fish than when they both came from untreated fish. Most mortality of sac fry in groups where the eggs came from treated fish occurred during the 15th week of development. This was the period of maximum utilization of yolk fat, thus indicating that insecticide residues in the eggs were released at this time and resulted in mortality. (Sjolseth-Washington)
W70-03515

UPTAKE AND RETENTION OF MALATHION BY THE CARP,

Michigan Univ., Ann Arbor. Dept. of Environmental Health.

Michael E. Bender.

The Progressive Fish Culturist, p 155-159, July 1969. 5 tab, 3 fig, 8 ref. Pub Health Serv. Grant ES-00016-02.

Descriptors: *Carp, *Pesticide residues, *Retention, Organophosphorus pesticides, Pesticide removal, Gas chromatography, Degradation, Persistence, Hydrolysis, Metabolism, Hydrogen ion concentration, Food chains.

Identifiers: *Malathion, *Residue distribution, Oral uptake, Aqueous uptake.

It was found that carp exposed to 5 mg/l of malathion for 4 days contained highest residue levels in the liver, and that flesh, blood, gills, and brain have decreasing concentrations. The residue half-life of malathion in carp was calculated to be 12 hours. The significance of such a rapid rate of breakdown is discussed. The differences between aqueous and oral uptake were determined. Uptake by the intestinal tract does not contribute a significant amount to the malathion residue. (Sjolseth-Washington)
W70-03516

THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS, RAFINESQUE),

Michigan Univ., Ann Arbor. Dept. of Environmental Health.

Michael Bender.

Water Research, Vol 3, p 571-582, 1969. 2 tab, 4 fig, 13 ref. US Public Health Serv Grant ES-00016-02.

Descriptors: *Hydrolysis, *Bioassay, *Degradation, Organophosphorus pesticides, Hydrogen ion concentration, Pesticide toxicity, Minnows, Mortality.

Identifiers: *Malathion, *Synergism, *Breakdown products, Pimephales promelas, DMPTA, Metabolites, Safe concentration.

Malathion undergoes hydrolysis in aqueous basic solutions to diethyl fumarate and DMPTA. The

toxicity of the products of malathion hydrolysis in the fathead minnow, *Pimephales promelas*, were evaluated. The studies were conducted by toxicity bioassays of 96 hr duration and continuous exposure test of 14 day duration. The results of the experiments demonstrated the following: (1) the basic hydrolysis product, diethyl/fumarate, was more toxic than malathion to the test species; (2) a pronounced synergistic effect was demonstrated between malathion and its two basic hydrolysis products; and (3) continuous exposure decreased the TL₅₀ concentration of malathion and its basic hydrolysis products. (Sjolseth-Washington)
W70-03518

EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE,

North Texas State Univ., Denton. Dept. of Biology. B. Dwain Vance, and David L. Smith.

Texas Journal of Science, Vol XX, p 329-337, Apr 1969. 1 tab, 41 ref.

Descriptors: *Herbicides, *Growth rates, *Algae, 2,4-D, Aminotriazole, 2,4-5-T, Scenedesmus, Chlamydomonas, Chlorella, Mortality, Bioassay, Inhibition, Mode of action, Photosynthesis.

Identifiers: Simazine 80 W, Dacthal.

Screening tests were made to determine if the herbicides Simazine 80W, Dacthal, Amitrol-T, 2,4-D, and 2,4,5-T were toxic to bacteria-free unicellular cultures of *Scenedesmus quadridaua*, *Chlamydomonas eugametos*, and *Chlorella pyrenoidosa* TX 7-11-05. Dacthal, Simazine, 2,4-D and 2,4,5-T showed no toxic effects on any of the algae at concentrations up to 200 ug/ml. Simazine increased the growth of C. eugametos in concentrations up to 200 ug/ml. Amitrol-T was inhibitory to all the algae at high concentrations but showed no effect at concentrations below 150 ug/ml. (Sjolseth-Washington)
W70-03519

BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE,

North Texas State Univ., Denton. Dept. of Biology. B. Dwain Vance, and Waymon Drummond.

Journal American Water Works Association, Vol 61, No 7, p 360-362, July 1969. 2 tab, 11 ref. US Public Health Serv Research Grant CC 00269.

Descriptors: *Algae, *Pesticide toxicity, *Pesticide removal, *Food webs, DDT, Chlorinated hydrocarbon pesticides, Aldrin, Endrin, Dieldrin, Scenedesmus, Gas chromatography, Resistance, Bioassay, Growth rates, Pesticide residues, Deterioration.

Identifiers: *Biological concentration, Anabaena cylindrica, Microcystis aeruginosa, Oedogonium.

Unicellular cultures of *Microcystis aeruginosa*, *Anabaena cylindrica*, *Scenedesmus quadridaua*, and *Oedogonium* sp. were grown in the presence of aldrin, dieldrin, endrin and DDT in concentrations of 5, 10 and 20 ug/ml. These algae are effective in accumulating pesticides from the medium in which they grow. In no case was concentration less than 100 fold. Algae were shown to accumulate detectable quantities within 30 minutes after exposure. The algae were shown to be highly resistant to the pesticide, except that dieldrin, aldrin, and endrin are alcidic to M. aeruginosa at concentration of less than 5 ug/ml. The authors feel that the ability of algae to concentrate pesticides without themselves succumbing may be a potential danger to organisms higher up the food chain. (Sjolseth-Washington)
W70-03520

SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT *Salmo gairdneri* RICHARDSON,

Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.

F. B. Eddy, and R. I. G. Morgan.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Journal of Fisheries Biology, Vol 1, p 361-372, 1969. 6 tab, 3 fig, 37 ref.

Descriptors: *Carbon dioxide, *Fish physiology, *Acclimatization, Rainbow trout, Toxicity, Respiration, Oxygenation.

Identifiers: *Fish blood, *Blood analysis, *Bohr effect, *Root effect, Oxygen capacity, Hematocrit, Hemoglobin, Blood iron content, Erythrocyte.

Various hematological measurements, including pH determinations were made on blood from rainbow trout acclimated to 40 ppm free CO₂ and 70 to 100 ppm free CO₂ in order to investigate any differences occurring in the respiratory properties of the blood. When equilibrated with various CO₂ tensions, blood from acclimated trout showed smaller Bohr and Root effects than blood from the non-acclimated trout. Blood from acclimated trout contained more hemoglobin which was not completely saturated with oxygen when equilibrated in air. Oxygen dissociation curves were constructed and evaluated. The authors concluded that rainbow trout can acclimate to some extent, to the stress of high CO₂ levels. Thus trout inhabiting water liable to pollution from CO₂ can accommodate this stress to some extent. (Sjolseth-Washington)

W70-03522

SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN),

Western Fish Disease Lab., Seattle, Wash.

Donald F. Amend, William T. Yasutake, and Reginald Morgan.

Transactions of the American Fisheries Society, Vol 98, No 3, p 419-425, 1969. 1 fig, 4 tab, 12 ref.

Descriptors: *Rainbow trout, *Bioassay, Water temperature, Dissolved oxygen, Calcium carbonate, Water pollution effects, Toxicity, Fish kill.

Identifiers: *Ethyl mercury phosphate, *Timsan, *Susceptibility, *Mercury, Water hardness, Chloride ions.

This study determined the influence of water temperature (55-68 deg), dissolved oxygen (4-12 ppm), water hardness as CaCO₃ (20-256 ppm), and chloride ions (to 2 mM) on the susceptibility of rainbow trout (*Salmo gairdneri*) to the acute toxicity of ethyl mercury phosphate (EMP). The fish were exposed for one hour to 0.125 ppm EMP, the active ingredient of Timsan, a commercial EMP formulation. The death rate because of the exposure to EMP increased with an increase in water temperature, a decrease in dissolved oxygen, and an increase in chloride ions; calcium appeared to have no effect. The effect of water temperature and dissolved oxygen was ascribed to changes in the respiration rate of the fish, and a chemical explanation is presented for the effect of chloride ions. (Sjolseth-Washington)

W70-03523

THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA,

Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.

R. Lloyd, and Lydia D. Orr.

Water Research, Vol 3, p 335-344, 1969. 6 fig, 19 ref.

Descriptors: *Ammonia, *Urine, *Acclimatization, Rainbow trout, Permeability, Fish physiology, Toxicity, Water temperature, Laboratory equipment.

Identifiers: *Diuresis, *Urine excretion rates.

The rate of urine excretion by rainbow trout increases with a rise in the concentration of ambient un-ionized ammonia. It is suggested that this diuresis is caused by an increase in the permeability of the fish to water. Quantitative measurements of urine excretion rates indicate that concentrations

of un-ionized ammonia below 12 per cent of the lethal threshold concentration may be without toxic effect. Increases in temperature produce no well defined trend in urine excretion rates with a given concentration of un-ionized ammonia, but normal excretion rates have a Q10 of 2.4. Some evidence is presented for acclimation of rainbow trout to sub-lethal levels of ammonia. It is suggested that any environmental factor which affects the water balance of fish may also influence their susceptibility to ammonia poisoning. (Sjolseth-Washington)

W70-03524

ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS,

Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

George G. Chadwick, and Robert W. Brocksen.

The Journal of Wildlife Management, Vol 33, No 3, p 693-700, 1969. 8 fig, 14 ref.

Descriptors: *Pesticide removal, *Pesticide residues, Dieldrin, Sculpins, Tubificids, Retention, Chlorinated hydrocarbon pesticides, Gas chromatography, Persistence, Pesticide toxicity.

Identifiers: *HEOD, *Accumulation rates, *Method of uptake, *Cottus perplexus*, Chironomidae.

The rate of uptake of HEOD (a dieldrin component) from contaminated water (0.017 to 8.6 parts per billion (ppb)) or food by the reticulate sculpin (*Cottus perplexus*) and fish-food organisms, tubificid worms (*Tubifex* sp.) and midge larvae (Chironomidae) was determined. Accumulation of HEOD by the fish was dependent on its concentration in the water, and the accumulation was nearly constant at each exposure level during the 32-day test period. The saturation level of HEOD in the fish apparently was never reached. Feeding experiments using contaminated tubificid worms as the food source, showed that the retention of HEOD by fish was inversely related to the amount of HEOD they consumed. Fish retained nearly all of the HEOD they consumed when given small amounts in their food, but they retained a much lower proportion of the available HEOD when given large amounts in food. Authors concluded that fish can accumulate HEOD both from the surrounding water and from their food, but accumulation of HEOD from the water does not appear to be additive with the HEOD accumulated from the food. (Sjolseth-Washington)

W70-03525

THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES,

Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.

Kenneth J. Macek, Curt Hutchinson, and Oliver B. Cope.

Bulletin of Environmental Contamination and Toxicology, Vol 4, No 3, p 174-183, 1969. 3 tab, 7 ref.

Descriptors: *Bioassay, *Pesticide toxicity, Rainbow trout, Water temperature, Mode of action, Pesticide removal, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Aldrin, Dieldrin, Endrin, Heptachlor, Fish physiology.

Identifiers: *Susceptibility, *Median tolerance limits, Bluegills, Chlordane, Lindane, Malathion, Methoxychlor, Endosulfan, Toxaphene, Pesticide uptake, Enzymatic activity.

The median tolerance limits to 15 pesticides were calculated for 24 and 96 hours of exposure at 1.6 deg, 7.2 deg and 12.7 deg C for rainbow trout and at 12.7 deg, 18.3 deg and 23.8 deg C for bluegills. The pesticides tested were aldrin, chlordane, naled, dieldrin, diuron, Dursban, endrin, azinphosmethyl, heptachlor, lindane, malathion, methoxychlor, endosulfan, toxaphene, and trifluralin. There was generally an increase in the susceptibility of fish to most pesticides tested as temperature increased. The authors feel this increased susceptibility to be

due to an increased level of enzymatic activity and possibly to the effect of temperature on metabolism. The authors stressed the need for considering interactions between pesticides and environmental factors when determining safe levels in aquatic habitats. (Sjolseth-Washington)

W70-03526

RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (*SALMO GAIRDNERI*) TO STRESS,

Michigan State Univ., East Lansing. Dept. of Physiology.

Cliff W. Hill, and Paul O. Fromm.

General and Comparative Endocrinology, Vol 11, No 1, p 69-77, 1968. 6 tab, 31 ref. FWPCA Grant WP 00807.

Descriptors: *Stress, *Chromium, *Fish physiology, Rainbow trout, Fluorescence, Test procedures.

Identifiers: *Plasma cortisol, *Plasma glucose, *Interrenal gland, Liver glycogen, ACTH.

Exposure of trout to environmental hexavalent chromium (0.02 and 0.2 mg/liter of water) for 1 week caused a significant elevation of plasma 'cortisol' as determined by fluorescence in sulfuric acid. Fish exposed to these concentrations for 2 and 3 weeks had plasma levels similar to those of controls. Forced exercise twice daily for 1 and 2 weeks did not give rise to elevated plasma 'cortisol' if samples were obtained 24 hours after the last exercise period. Fish forced to swim and sampled immediately did have plasma 'cortisol' levels significantly above those of controls. Animals treated with exogenous cortisol had plasma 'cortisol' levels over 100 ug/100 ml. Fasted fish so treated for 1 week had higher liver glycogen stores and excreted more waste nitrogen than did control fish. Plasma glucose was not elevated in treated fish. Animals similarly treated but fed during the experimental period had liver glycogen stores and nitrogen excretion rates similar to those of controls. (Sjolseth-Washington)

W70-03527

THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, *ARTEMIA SALINA*,

Food and Drug Administration, Washington, D.C. Div. of Microbiology.

R. F. Brown.

Journal of the American Oil Chemists' Society, Vol 46, No 2, p 119, 1968. 1 fig, 3 ref.

Descriptors: *Brine shrimp, *Bioassay, Mortality, Toxins.

Identifiers: *Aflatoxin B1, *Ochratoxin A, *Artemia salina*, Aflatoxins, Mycotoxins.

The chemical determination of mycotoxins in foods using bioassay techniques with the brine shrimp, *Artemia salina*, was discussed. Aflatoxin B1, at dose levels of 1.0 ug/ml and above, produced over 90% mortality after 24 hours. At 0.5 ug/ml there was a 61% mortality of *Artemia*. Ochratoxin A, at 1.0 ug/ml produced a 15% mortality; at 2.0 ug/ml, mortality was 23%; at 16.0 ug/ml, mortality was 49%. Further investigation is warranted on the possibility of using brine shrimp as a bioassay for other mycotoxins. (Sjolseth-Washington)

W70-03528

COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (In Russian),

Akademiya Nauk URSR, Kiev. Instytut Hidrobiologii.

S. I. Abramskaya.

English summary. Gidrobiologicheskii zhurnal, Vol 5, No 1, p 38-42, 1969. 1 tab, 8 ref, 2 fig.

Descriptors: *Cooling, *Reservoirs, Environmental effects, Thermal pollution, Dissolved oxygen, Chemical properties, Ponds, Photosynthesis.

Effects of Pollution—Group 5C

Identifiers: Cooling ponds, Effects on chemical properties, Temperature effects.

Hydrochemical characteristics of cooling ponds of 5 Ukrainian electrical power stations were examined in this study. The waters of the Kurakhov and Zuyer cooling ponds were characterized by high mineralization and hardness; the total ions were somewhat lower in the Lupansk and Zmiyer cooling ponds, and the lowest values were found in the cooling pond of the Krivoi Rog electric power station. The discharge of heated waters did not substantially effect the ion-salt components of the ponds. The content of biogenic and organic substances and gas condition in the ponds depended chiefly on local conditions of effluents and internal processes. The ponds studied were eutrophic and mesotrophic according to their production levels. The effect of increased temperature was mostly visible in gas production and in the dynamics of organic and biogenic substances. According to winter data, the pH in heated parts of the ponds was somewhat higher than in cooler areas. It is probable that photosynthesis is more active in the heated parts in this period, which favors more intensive accumulation of organic matter. Also, BOD was much higher in heated than in cool portions. As a result of increased temperature, solubility of O₂ in the cooling ponds decreased. The concentration of O₂ in the heated parts of cooling ponds in winter was lower than in parts under natural conditions. Local decrease of O₂ content in warm parts may be explained also by higher mineralization of organic matter and respiration of hydrobiants. The content of biogenic elements in warmer parts of the ponds was somewhat lower than in cooler portions, which may be explained by their greater consumption by phytoplankton. The quality of waters in cooling ponds can be improved by maximum water-exchange and the removal of excess salts. (Novotny-Vanderbilt)

W70-03539

THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER,

Frederic F. Fish.

Scientific Monthly, Vol 66, p 283-292, 1948. 2 tab.

Descriptors: *Columbia River, *Grand Coulee Dam, *Relocation, Spawning Brood Stock.

Identifiers: *Parent Stream Theory, Blueback salmon.

The year 1941 was a critical one for the blueback salmon of the Columbia River, for one brood of the species came very close to extinction. Only 949 fish were counted passing Rock Island Dam to the spawning grounds. The most acceptable explanation for the small number of fish reaching the spawning grounds lies in the abnormally warm water temperatures that prevailed that year. The high temperatures are believed to have caused the blueback to turn into downstream tributaries seeking relief from the warm water, and to have established a favorable environment for *Chromococcus columnaris*. As a result of the construction of Grand Coulee Dam, which blocked the entrance to the upper Columbia blueback spawning grounds, the Fish and Wildlife Service began a relocation project which was predicated upon the assumption that the young of the relocated fish would return to the streams in which they were reared, and not to their ancestral spawning areas. The fish were trapped in the fish ladders at Rock Island Dam and trucked to hatcheries where young were artificially propagated. The relocation project was begun in 1940, but it was not until 1943 that an effective disinfectant was found which eliminated all infectious diseases without danger to the blueback fingerlings. By that time a diet had been compounded which met all nutritional requirements of the fish. The loss of eggs and fingerlings was reduced from 83.4% in 1940 to 16.3% in 1943. The 1947 run demonstrated the success of the 1943 hatch, when 204,489 fish were estimated in the Columbia River. The estimated run in 1945, progeny of the fish trapped in the 1941 run was only 9,269. The relocation project appeared to

have been successful and the blueback salmon had returned to the Columbia River. (Speakman-Vanderbilt)

W70-03546

EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS,

Technische Hochschule, Aachen (West Germany). B. Boehnke.

Purdue University, Eng Bull, PT 2 Ext Ser No 129, p 752-770, 1967.

Descriptors: Water pollution effects, *Cooling water, *Thermal pollution, *Self-purification, *Organic loading, Wastes, Waste assimilative capacity, Rivers, Watersheds (Basins), Biochemical oxygen demand, Oxygen sag, Dissolved oxygen.

Results achieved within the area of the Lippe Association illustrate what effect biological degradable industrial wastes may have on the self-purification capacity of flowing waters and what measures were, and still are, necessary for observing and improving conditions within a river basin. The effects of biological degradable industrial waste water and the discharge of cooling water on the self-purification capacity of the Lippe River can be estimated with satisfactory accuracy for long stretches of the river. The method of calculating the effect of organic loads on the process of self-purification as employed by the Lippe Association has proved to be a valuable help in establishing economical improvement schemes, in specific treatment measures, and in fixing contributions. It is an essential condition that O₂ replenishment via the water surface and degradation rates within the river be known. Although the complex conditions prevailing in a water course rule out an exact precalculation of O₂ conditions, as a characteristic feature of the process of self-purification under changing load conditions, it is possible to make a reliable estimate of biological processes. This will materially assist an engineer in his designs and studies and will help him in making necessary decisions. (Novotny-Vanderbilt)

W70-03547

THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY,

Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.

Peter A. Krenkel, William A. Cawley, and Virgil A. Minch.

Journal Water Pollution Control Federation, Vol 37, No 9, p 1203-1217, Sept 1965. 16 fig, 14 ref.

Descriptors: *Impoundments, *Waste assimilative capacity, Dissolved oxygen, Stratified flow, Backwater, Peak Power, Cooling water, Unsteady flow, Temperature, Thermal pollution.

Identifiers: *Weiss Reservoir, *Coosa River.

The major undesirable conditions which affect the observed reduction in waste assimilation capacity of previously unregulated rivers by the construction of impounding reservoirs are described. These major factors are the inherent low dissolved oxygen values in stratified reservoirs, the backwater conditions created by the downstream reservoir, the peaking power operations, and the stratified flow conditions induced by the discharge of cooling water into deep, slow-moving backwaters. The data presented show that the conditions created by the closure of Weiss Reservoir have reduced the waste assimilative capacity of the Coosa River by 80 percent of that obtained in the pre-impoundment free-flowing stream. The causes are the presence of the backwater curve caused by the Weiss Reservoir, unsteady flow conditions created by the cyclic power releases from the upstream Allatoona Reservoir, the stratified flow conditions created by the discharge of a heated power plant effluent, and the inherent changes in normal water quality caused by the presence of both reservoirs. (Rietveld-Vanderbilt)

W70-03550

EFFECT OF WATER TEMPERATURE ON DISCHARGE AND BED CONFIGURATION, MISSISSIPPI RIVER AT RED RIVER LANDING, LOUISIANA,

Corps of Engineers, Washington, D.C. Committee on Channel Stabilization.

P. P. Burke

Committee on Channel Stabilization, Corps of Engineers, Technical Report No. 3, Aug 1966. 45 p, 6 fig, 6 tab, 18 ref.

Descriptors: *Water Temperature, Viscosity, Shape, River bed, Sand waves, Mississippi River.

Identifiers: Alluvial river, Gage hydrograph, Flood damage potential, Bed form, Configuration changes, Discharge.

The configuration of the bed of an alluvial river varies in accordance with the temperature of the water. Crossings and bends are lowered and systematic sand waves are reduced in amplitude in a direct relation to decreasing water temperatures. The mechanism by which this occurs may be physical or chemical, or a combination of the two. Routine surveys made for other purposes afford a quantity of basic data to delineate changes in bed configuration. An examination of the basic data from field observations and from official Mississippi River Commission publications indicates water temperature has a real effect on bed form configuration. There is a need for continued investigation in this field through model study and field observations of the prototype. The presentation of these data is only a beginning and no attempt is made to explain the complicated mechanisms by which temperature accomplishes its apparent effect on sediment movement and deposition. Ross-Vanderbilt

W70-03552

AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, *SALMO GAIRDNERII* Richardson,

Toronto Univ. (Ontario). Dept. of Zoology.

David E. Craigie.

Canadian Journal of Zoology No 41, p 825-830, 1963. 2 fig, 2 tab, 5 ref.

Descriptors: *Water temperature, *Hardness, *Fish behavior, *Rainbow trout, Thermal stress, Saline water, Salinity, Trout, Fish, Environmental effects.

Identifiers: *Thermal resistance, *Salmo gairdnerii*, Hardwater, Softwater.

Resistance to thermal stress was studied in 2 groups of yearling trout (*Salmo gairdnerii*) in soft and saline waters at 27, 28, and 29 deg C. In all cases the group reared in soft water showed greater resistance to thermal stress than the group reared in hard water but otherwise under similar conditions. This difference in thermal resistance was associated not with experience in the development period (between fertilization and final adsorption of the yolk sac) but with experience in the subsequent growth period. It was also confirmed that increased salinity in the testing medium increased the thermal resistance; with fish reared in hard water, this effect was insignificant at a relatively low lethal temperature (27 deg C) but increased at higher temperatures, while with fish reared in soft water the advantage of increased salinity was significant at all 3 temperatures but greater at 28 deg C than at either 27 or 29 deg C. (Rietveld-Vanderbilt)

W70-03554

TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT,

University of the Witwatersrand, Johannesburg (South Africa). Dept. of Zoology.

T. R. Badenhuizen.

Hydrobiologia, No 30, p 541-554, 1967. 6 fig, 1 tab, 11 ref.

Descriptors: *Water temperature, *Fish behavior, *Fish, Thermal pollution, Temperature, Environmental effects.

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

Identifiers: *Temperature gradient, Tilapia mossambica, Temperature preference.

Investigations were made of the effects of temperature on juvenile Tilapia mossambica in long 21-compartment horizontal tanks with further compartments at either end containing an immersion heater and an ice block respectively, the fish being able to pass along the tank by swimming under the partitions, which were raised from the bottom. With no temperature gradient along the tank the distribution was not random, owing to congregation of the fish towards the ends of the tanks, but when a temperature gradient was applied, the fish preferred to congregate in compartments in which the temperatures ranged from about 27 deg C to 33.5 deg C. Selected temperatures were higher than those occurring in the natural habitat of the fish. These results confirm that death of Tilapia in highveld dams in winter is due to low temperatures. (Rietveld-Vanderbilt)

W70-03556

EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRAE AND FIN RAYS IN YOUNG CHINOOK SALMON,

Washington Univ., Seattle. Lab. of Radiation Ecology.

Allyn Seymour.

Transactions of the American Fisheries Society, Vol 88, No 1, p 58-69, 1959. 7 fig, 4 tab, 31 ref.

Descriptors: *Temperature, *Chinook salmon, *Eggs, Fish, Fish physiology.

Identifiers: *Vertebrae, *Fin rays, Fingerlings, Fish development.

Experiments in each of three successive years were designed to observe the effect of temperature upon chinook salmon, *Oncorhynchus tshawytscha*, during the period from the egg to the fingerling stage. Experimental temperatures ranged from 34 deg F to 74 deg F but there were no survivals to the stage where vertebrae or fin rays could be counted for lots reared at temperatures below 39 deg F or above 62 deg F. Two experiments were conducted at constant temperatures, while, in the third, the temperatures were lowered to 34 deg F from their initial levels at the rate of 1 deg F per 5 days. The temperatures were then held at 34 deg F for twenty days, after which they were raised 1 deg F per 5 days. For these experiments the average numbers of vertebrae per lot was less for lots reared at temperatures in the middle portion of the 39 deg F to 62 deg F range than for lots reared at either extreme of the range. The same effect was observed in regard to the number of individuals with abnormal vertebrae, but the opposite effect was observed in regard to the numbers of rays in the anal and dorsal fins. The difference in the average number of vertebrae of lots reared at various temperatures was less than the difference in the average number of vertebrae between the four stocks. The average numbers of vertebrae in the lots from the Sacramento River (California) and the three Washington rivers - Skagit, Green and Entiat - and reared at the same temperature (56 deg F) were respectively 66.39 plus or minus .047, 68.36 plus or minus .052, 69.57 plus or minus .23, and 71.73 plus or minus .031. For all lots the range in number of vertebrae was 63 to 78. (Speakman-Vanderbilt)

W70-03557

EFFECT OF HEAT ON THE LIGHT BEHAVIOUR OF FISH,

Toronto Univ. (Ontario).

C. W. Andrews.

Transactions, Royal Society of Canada, Section V, p 27-31, 1946. 2 fig, 1 ref.

Descriptors: Temperature, Light, Behavior, Acclimatization, Suckers, Fish behavior, Thermal pollution, Fish attractants, Fish repellants, Light intensity.

The effect of heat on the light behavior of the common sucker (*Catostomus commersonii*) has been studied. Two-year-old suckers were found to be

negatively phototactic at depths of 8 and 12 inches, while they were positively phototactic at 16 inches or more depth. All sizes tested were found to become insensitive to light at temperatures less than lethal and they regained light sensitivity if the temperatures were lowered again. The temperature of insensitivity to light decreased with increased age. The temperature of insensitivity to light varied directly with temperature of acclimation, increasing from 20.3 deg C to 32.5 deg C for acclimation temperatures of 5 deg C to 22 deg C respectively, for light of constant intensity. The temperature of insensitivity also varied directly with light intensity, increasing from 10.5 deg C to 20.5 deg C for relative light intensities of 1 and 1000 respectively. (Speakman-Vanderbilt)

W70-03558

WATER TEMPERATURE AND SPRING FISHING, NORRIS RESERVOIR, TENNESSEE,

Tennessee Valley Authority, Norris.

Jack S. Dendy.

Journal, Tenn. Academy of Science, Vol. 21, p 89-93, 1946. 2 fig, 1 tab, 4 ref.

Descriptors: *Temperature, *Fishing, Spring, Stratification, Thermal stratification, Fish behavior, Creel census, Fish, Fish management, Tennessee.

Identifiers: *Norris Reservoir, Clinch River.

During the early spring of 1945, water temperatures were taken at regular intervals at three stations on Norris Reservoir. One station was in the deepest portion of the Reservoir, another in a moderately shallow area about 25 miles above the dam, and the third about midway between the other two. As expected, the water temperature increased more rapidly in the upper portion of the Reservoir than in the deeper parts near the dam. The surface water was consistently much warmer at the upstream station than at the deepwater station until early April. Inquiries of anglers and dock operators showed that anglers were taking fish in the upstream area as early as March 1, while at the deep water station the fish had not begun to bite. By early April, however, fishing in the downstream area was almost as good as in the upper region. (Speakman-Vanderbilt)

W70-03559

INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS,

Bureau of Commercial Fisheries, Gulf Breeze, Fla. Biological Lab.

H. T. Holland, David L. Coopage, and Philip A. Butler.

Transactions of American Fisheries Society, Vol 95, No 1, p 110-112, 1966. 2 fig, 3 ref.

Descriptors: *DDT, *Endrin, *Bioassay, Resistance, Chlorinated hydrocarbon pesticide, Mortality, Fishkill, Pesticide toxicity, Water pollution effects.

Identifiers: *Sensitivity, *Sheepshead minnows.

Sheepshead minnows were exposed to 20 to 40 ppb DDT in aquaria for 24 hours. Survivors of DDT tests in which mortality exceeded 90% (R1 fish) and survivors of DDT with mortality from 55 to 90% (R2 fish) were transferred to artificial pools similar to the natural environment. The young of these fish and control fish were exposed to DDT (10, 13, and 15 ppb) and endrin (2 ppb). R1 young under went higher mortalities than the controls in all tests. Mortality of R2 young was greater than controls at 13 ppb DDT and in endrin. The authors feel these data indicate that a population of sheepshead minnow could tolerate an occasional heavy mortality. The increased sensitivity of the F1 generation indicate that serious mortality may result following low levels of pesticide contamination. (Sjolseth-Washington)

W70-03621

AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS,

Bureau of Commercial Fisheries, Gulf Breeze, Fla.

David J. Hansen.

Transactions of American Fisheries Society, Vol 98, No 3, p 426-429, 1969. 3 tab, 1 fig, 5 ref.

Descriptors: *DDT, *Endrin, *2-4-D, *Fish behavior, Pesticide toxicity, Bioassay, Research equipment, Fish repellents, Organophosphorous pesticides.

Identifiers: *Avoidance, *Malathion, *Dursban, *Sevin, Sheepshead minnows, Ecological implications, Median tolerance limits, Pesticide concentrations.

The capacity of sheepshead minnows, *Cyprinodon variegatus* to avoid various concentrations of six pesticides (DDT, endrin, malathion, Dursban (R), Sevin (R), and 2-4D) was investigated. Test fish avoided water containing DDD (down to .005 ppm), endrin (.0001 ppm), Dursban (.1 ppm), and 2-4D (.1 ppm). The fish did not avoid the test concentrations of malathion or Sevin. When fish were exposed simultaneously to two different concentrations of the four pesticides that were avoided, they avoided the highest concentration of 2,4D but preferred the higher concentration of DDT. Fish did not discriminate between other concentrations of 2,4D or between different concentrations of endrin or Dursban. (Sjolseth-Washington)

W70-03622

SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES,

Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.

J. S. Alabaster.

International Pest Control, Vol II, No 2, p 29-35, Apr 1969. 1 fig, 7 ref, 7 tab.

Descriptors: *Bioassay, *Chlorinated hydrocarbon pesticides, *Organophosphorus pesticides, *Herbicides, *Fungicides, Pesticide toxicity, Pesticide residues, DDT, Rainbow trout, Brown trout, Hydro ion concentration, Analytical techniques, Hardness (Water).

Identifiers: *Rasbora heteromorpha (Harlequin), *Wetting agents, Plaice, Sheepdip.

Tests by the Salmon and Freshwater Fisheries Laboratory in London were conducted to measure the toxicity of 164 pesticides to fish. Harlequin fish (*Rasbora heteromorpha*), rainbow trout, brown trout and plaice were the test fish. The 24 and 48-hour median lethal concentrations, together with the estimated mean threshold values (concentration at which 50% of the fish would be killed in 3 months) are given for herbicides, fungicides, insecticides, excluding DDT and sheep dips, wetting agents and miscellaneous substances. In general the relationship between the logarithm of survival time and the logarithm of material concentration is nonlinear, often indicating a threshold concentration for survival. The results suggest it is essential to test actual pesticide as sold rather than rely on figures available for the toxicity of the ingredients. In only very few cases was the toxicity of a formulated compound dependent simply on the amount of active ingredient. (Sjolseth-Washington)

THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM,

California Univ., Davis. Dept. of Zoology; and California State Dept. of Fish and Game, San Francisco.

S. F. Cook, Jr., and R. L. Moore.

Transactions of American Fisheries Society, Vol 98, No 3, p 539-544, 1969. 3 ref, 6 fig.

Descriptors: *Rotenone, *Aquatic insects, Water pollution effects, Diptera, Caddisflies, Mayflies,

Waste Treatment Processes—Group 5D

Persistence, Larvae, Treatment, Fish control agents.

Identifiers: *Recovery, *Insect fauna, Russian River, California, Ephemeroptera, Trichoptera, Simuliids.

The population levels of the major insect groups subsequent to rotenone treatment in the treated and untreated zones in Robinson Creek were examined in both pools and riffles. A great resurgence of insect fauna after their initial near annihilation in the treated zone was noticed. The simuliids were the first major group to make a comeback in the treated riffles. Within two weeks they had taken over all available attachment space in the riffles. The authors feel that elimination of potential predators may account for this resurgence. It appears as if rotenone treatment had little lasting effect upon the non-target insect fauna of significance as fish forage. The authors caution relating these data to other instances of stream poisoning, since only a portion of Robinson Creek was treated. Season of treatment, sampling biases, and possible undetected species shifts are other points to be considered in evaluation of such projects. (Sjolseth-Washington)

W70-03624

5D. Waste Treatment Processes

INJECTION WELL EXPERIENCE AT RIVER-HEAD, N.Y.

Baffa (John J.), New York.

For primary bibliographic entry see Field 04B.

W70-03249

OPPORTUNITIES FOR WATER SALVAGE,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

Lloyd E. Myers.

Civil Engineering - ASCE, Vol 40, No 1, p 41-44, Jan 1970. 4 p, 2 photo, 1 tab.

Descriptors: *Water reuse, *Reclaimed water, Tertiary treatment, Water supply, Irrigation water, Water management (Applied), Water resources development, Evaporation, Water harvesting, Evaporation control, Water conservation.

Identifiers: Water salvage techniques.

While the focus of attention for increasing water supplies has been on developing new supplies, there has been a relative neglect of the equally important sources of supply in water salvage. Some of these sources, such as wastewater reclamation and reuse of water by industry, are economically feasible today. Others such as reducing some irrigation use, are feasible today but their development will be delayed by social and economic factors which are difficult to predict. Such sources as vegetation management and water harvesting, can be expected to become economically feasible and socially acceptable within the next decade. These water salvage methods will ultimately make a major contribution to the solution of water supply problems. (Knapp-USGS)

W70-03251

ISRAEL TURNS TO SEWAGE FOR WATER.

Engineering News Record, Vol 183, No 19, p 42-43, Nov 6, 1969. 2 p, 1 fig, 3 photo.

Descriptors: *Water reuse, *Tertiary treatment, *Artificial recharge, Water spreading, Aerobic treatment, Anaerobic treatment, Arid lands, Desalination, Reclaimed water, Groundwater movement, Aquifers, Pumping.

Identifiers: *Israel.

With 90% of its water potential now being used and faced with the prospect of a 20% to 30% increase in demand for the next decade, Israel is turning to raw sewage as a source of supply. Under construction is a waste water reclamation project expected to hike

the nation's supply by 12%. The effluent, to be reclaimed by treatment in sophisticated lagoons, will not be put into use directly but will be infiltrated into the ground and later recovered by wells. The spreading basins will be located in sand dunes that connect directly with the underlying sand-and-sandstone aquifer that is one of Israel's principal stores of groundwater. The treatment phases of the various lagoons include anaerobic lagoons, facultative lagoons, aerobic lagoons and a polishing lagoon. The spreading lagoons will be operated in rotation to allow for drying periods between successive fillings to prevent clogging. The infiltrated water will take one year or more to reach the periphery of the recharge area, where an encompassing string of borehole wells will recapture the water as a potable supply. Salinity will be about 300 ppm. Most of the reclaimed water will be used for irrigation. (Knapp-USGS)

W70-03270

EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS.

California State Dept. of Water Resources, Fresno; and Federal Water Pollution Control Administration, Fresno, Calif.

Randall Brown, and James Arthur.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 80-97. 12 fig, 1 tab, 1 ref.

Descriptors: *Surface, *Volume, *Carbon dioxide, *Aeration, *Nitrates, *Cultures, *Scenedesmus, *Subsurface waters, *Agriculture, *Wastes, Algae, Assay, Dissolved solids, Chemical analysis, Phosphates, Iron compounds, Hydrogen ion concentration, Alkalinity, California, Light intensity, Temperature, Ions, Spectrophotometry, Suspended load, Fluorescence, Sumps.

Identifiers: Stripping, Firebaugh Center (Calif), Scenedesmus quadricauda, Cell counts, Species determination, Absorbance, Coenobia, Swirling, Volatile solids.

A method of removing nitrate-nitrogen from subsurface agricultural drainage water-algae stripping—encourages algal growth, nitrate is converted to cellular materials, and algae separated from liquid phase by centrifugation, flocculation, etc. This water, high in dissolved salts, is not a complete media for Scenedesmus (the alga used) growth. Laboratory studies are conducted to determine nutrient additions necessary for optimum growth (and nitrogen removal). One experiment determined effect of flask size, surface/volume ratio, and type of mixing (including aeration and carbon dioxide addition). Surface/volume ratio showed maximum growth or nitrogen removal occurred in 250-milliliter flasks containing 125 milliliters of culture. Compressed air alone effected a similar growth rate as compressed air enriched with carbon dioxide, neither additive affecting ultimate yield. In the agricultural drainage water used, carbon was probably a limiting element and rate of exchange across the surface of the culture was not sufficiently rapid with swirling only. The 7.3 - 7.6 pH range difference affected nutrient availability. In determining optimum amount of iron and phosphorus for nitrogen removal, type of mixing was significant. Measurement of the nitrate parameter by the specific ion electrode method can produce a rapid and reliable estimate of algal activity. (See Vol. 3, no. 7, Field 5C, entry W70-02775). (Jones-Wisconsin)

W70-03334

A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES,

Chicago Univ., Ill. Center for Urban Studies; and Bauer Engineering, Inc., Chicago, Ill.

John R. Sheaffer, Fred Roland, and Wayne Cowlishaw.

To be available also in US Congress, House Committee on Government Operations, Sub-Comm on Conservation and Natural Resources, hearings on phosphate based detergents, Dec 16-17, 1969, Wash, DC, 1970. A statement before the Conservation and Natural Resources Subcommittee of the House Committee on Government Operations on matters relating to the hearings on Phosphate-based Detergents, Dec 16-17, 1969. 15p.

Descriptors: *Water quality, *Phosphates, *Waste water treatment, Biochemical oxygen demand, Nitrates, Water pollution sources, Fertilizers, Waste storage, Aerobic treatment, Settling basins, Soil disposal fields.

Identifiers: Muskegon County (Mich).

The management of phosphates and water quality needs to utilize a comprehensive approach to waste water management. Past efforts at waste water management have been characterized by disjointed incrementalism, i.e., many different governmental bodies become involved in water quality control, decentralizing and weakening the total program. A new approach to waste water management is based on three underlying concepts. They are: first, pollutants are resources out of place; two, waste water management systems must be designed as closed systems; and third, the environment is a total entity. A waste water management plan is outlined based on a plan developed for Muskegon County, Michigan. This plan proposes the use of waste water for irrigation purposes on nutrient deficient soils. Waste water is transported from an urban area to a location with suitable environmental geologic condition where a lagoon system provides for aeration to satisfy biological oxygen demand, settling to remove settleable solids, aerobic bacteria to consume soluble organic wastes, and photosynthetic cells to convert nitrates and phosphates into algal cell material that can be retained by the soil. After treatment in the lagoon system, the waste water is applied to geologically suited land areas, turning previously unproductive land into valuable cropland. (David-Chicago)

W70-03346

FOAM SEPARATION OF KRAFT PULPING WASTES.

Georgia Kraft Co., Rome. Research and Development Center.

FWPCA Grant No WPRD 117-01-68. Available from the Clearinghouse as PB-189 160, \$3.00 in paper copy, \$0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-3, Oct 1969. 81 p, 2 tab, 14 fig, 28 ref, 5 append. FWPCA Program No 12040 EUG.

Descriptors: *Foam separation, *Pulping wastes, *B.O.D. removal, Tall oil removal, *Foaming reduction, *Solids removal, Treatment costs.

Laboratory studies of foam separation were conducted to determine the feasibility of this process for reducing B.O.D., solids content, and foaming tendency of clarified kraft mill effluent. Since kraft pulping wastes have a natural tendency to foam, it was expected that the foaming process, which has been found to be useful in treating domestic wastes, might have applications in treatment of these effluents. Both continuous flow and batch experiments were conducted, and liquid and foam heights, liquid feed rates, air sparging rates, and temperature were varied over wide ranges. The B.O.D. reduction in the treated liquid was disappointingly small, averaging less than 5 per cent, and the B.O.D. enrichment in the foam phase was in most cases less than 1.5 times that of the feed. Solids removal was correspondingly low. Foaming tendency, however, was significantly reduced by the intentional foaming process with reductions of 40 to 60 per cent in this variable being obtained. The reduction in foaming tendency was a strong function of gas-to-liquid ratio with the most effective operating range being between 1.0 and 1.5 SCFM/gallon. The experimental results suggest that the reductions in B.O.D. and foaming tendency were related to the separation of the tall oil

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

components of the waste. These components were concentrated in the foam fraction, but they accounted for a maximum of only 10 to 12 per cent of the B.O.D. of the raw feed. Apparently the remaining B.O.D.-producing materials were not surface active and did not attach themselves to the surface-active components. The cost of using a foam process on kraft mill wastes is estimated to be four to five cents per 1000 gallons of feed; this cost is exclusive of further processing of the concentrated foamate. Based on control of foaming tendency alone, the process would be unattractive from a cost standpoint.

W70-03350

FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS,

Wisconsin Univ., Madison. Water Resources Center.

Y. Misaka, and L. B. Polkowski.

Available from the Clearinghouse as PB-189 162, \$3.00 in paper copy, \$0.65 in microfiche. Wisconsin Water Resources Center, Technical Report OWRR A-006-Wis, June 1969. 198 p, 60 ref, 8 append. OWRR Project A-006-WIS.

Descriptors: *Flocculation, *Filtration, *Activated sludge, *Anthracite, Organic matter, Reclaimed water, Regressional analysis, Water pollution treatment, Protozoa.

Identifiers: *Sewage treated effluent, *Advanced waste treatment, *Sand, Filter backwashing, Experimental design.

Laboratory filtration studies were conducted on treated sewage effluent from a pilot activated sludge plant operated to provide effluent and mixed liquid solids for use in the experiments. The filtration media used were sand and a combination of anthracite and sand layers. To evaluate the filtration performance, statistical methods of experimental design and data analysis were applied. The major parameters varied for the experimental runs were flow rate, suspended particle size, suspended solid concentration, size of sand, size of anthracite, and depth of anthracite. Evaluation of filter performance was based on the amount of water produced per filtration run with an acceptable quality of filter effluent. Filtration performance ranged from 78 to 2430 gal/sq. ft. surface area for sand beds and from 488 to 4218 gal/sq. ft. for anthracite-sand beds. The concentration of the suspended solids in the influent applied was the most influential factor affecting performance and size of the top layer was the second most important factor as determined by regression analysis. Particle size of suspended solid applied was the third most important variable in terms of effect on performance when media size increased. The strength of the floc used was classified as 'strong' according to Hudson's breakthrough index. (Kerrigan-Wisconsin)

W70-03353

CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT,

Washington Univ., Seattle. Dept. of Civil Engineering.

Kristian Guttormsen, and Dale A. Carlson.

Available from the Clearinghouse as PB-189 232, \$3.00 in paper copy, \$0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-14, Oct 1969. 108 p, 14 fig, 15 tab, 103 ref, 3 append. FWPCA Grant No. WP-01486-01, Program 12060.

Descriptors: *Waste treatment, *Potatoes, *Water pollution control, *Industrial wastes, Sewage treatment, Water reuse, Reclaimed water, Tertiary treatment, Lagoons, Spray irrigation, Filtration, Oxidation lagoons, Bibliographics, Costs, Byproducts.

Identifiers: Potato waste treatment.

Potato processing, waste treatment, and current and needed research in water quality control in this

production field are discussed. A brief description is given of general characteristics of the potato and the effects and importance of cultural and environmental conditions on potato processing. General descriptions of the production processes are included and the literature is extensively reviewed to present current and proposed waste treatment technology. The most urgent research needs are discussed together with suggested methods for meeting these needs. (Knapp-USGS)

W70-03433

POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION: GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS,

North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.

For primary bibliographic entry see Field 05G.

W70-03438

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4,

American Water Works Association, New York.

For primary bibliographic entry see Field 05E.

W70-03442

Biodegradable detergents: recent problems and progress.

Textile Manufacturer, Vol 91, p 472-473, Nov 1965.

Descriptors: *Detergents, *Biodegradation, *Surfactants, *Foaming, *Biochemical oxygen demand, Soaps, Treatment facilities.

Identifiers: Alkyli benzene sulfonates, Textile wastes.

Principal synthetic detergents or 'surfactants' are the sodium salts of alkyl benzene sulphonates. When made from branched hydrocarbon chains of 12-15 carbon atoms, the detergent is 'hard' and is only 50% biodegradable in sewage. Foam accumulation in sewage facilities results, and in river water one month is required for 75% detergent decomposition. Detergents with straight hydrocarbon chains, 'soft' detergents, are biodegradable 'to a much greater extent' than the 'hard', but cause a rise in sewage biological oxygen demand. 'Soft' detergents can be made using the Ziegler technique of catalytic polymerization of ethylene. (Sheffield-North Carolina State)

W70-03530

AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY.

American Dyestuff Report, Vol 44, p 655-661, 1955. 58 ref.

Descriptors: *Domestic wastes, *Biochemical oxygen demand, *Biological treatment, Water pollution effects, Waste treatment, Toxicity, Alkalinity, Detergents, Coagulation, Chemical precipitation, Biodegradation.

Identifiers: *Wool, *Dyeing wastes, *Scouring waste, Textile wastes, Fiber wastes, Recovery (Waste), Acid dyes, Wool grease.

Waste composition from an individual woolen mill is determined by the processing steps performed in the plant. Wool-scouring wastes are the strongest pollutants. Significant polluting characteristics of woolen wastes include a rise in oxygen demand, suspended solids, acidity, alkalinity, color and grease. Undesirable odor also occurs. When discharged into a stream, these deplete oxygen, change the stream's physical properties, and are toxic to stream life. Four steps in dealing with a waste problem are (1) waste saving (economy and substitution), (2) byproduct recovery, (3) combined treatment with municipal sewage, and (4) treatment of residual waste. The quality of final plant effluent depends on state and local regulations based on stream condition and use. (Sheffield-North Carolina State)

W70-03531

'AN ANSWER TO STREAM POLLUTION': STREAM POLLUTION REDUCTION PROGRAM FOR FINISHING PLANT.

Textile Industries, Vol 121, No 7, p 71-73, 1957. 1 map, 1 fig.

Descriptors: *Treatment facilities, *Biochemical oxygen demand, Waste treatment, Economics, Activated sludge, Toxicity, Flow rates, Fish.

Identifiers: *Bleaching wastes, *Finishing wastes, Starch, Dyeing wastes.

The Hohokus Bleachery, Inc., using a new biological-type effluent-treatment plant, eliminates the oxygen depletion, discoloration, and odor caused by wastes in its discharge stream. Concentrated dyewaste residues are collected and removed from the premises, leaving bleaching and finishing wastes (peroxides and starches) for treatment. Before operation begins, the two aeration tanks are seeded with microorganisms, and sources of nitrogen and phosphorus for the biological processes are added. Raw waste is fed across the length of the tanks at a rate of two cubic feet/minute, allowing microorganisms to grow up to equilibrium. Compressed air enters the tank at a rate of 200 cubic feet/minute. In quiescent tanks, sludge settles out and clear effluent flows through a weir into the stream. The two tanks treat a total of 44,000 gallons/day, removing about 1,000 pounds of oxidizable material. The process requires no neutralization of waste before treatment and produces effluent of pH 7.9-8.3. The plant cost is one-third that of conventional plants, and maintenance-process control requires one man-hour/day. (Sheffield-North Carolina State)

W70-03537

THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR.

Bechtel Corp., San Francisco, Calif.

H. S. Riesbol, J. B. Anderson, F. H. Wend, and H. T. Holmes.

ASCE National Water Resource Meeting, Memphis, Tennessee, Jan 26-30, 1970. Preprint, 43 p, 17 fig, 9 ref.

Descriptors: *Cooling, *Reservoirs, *Heat transfer, *Heat balance, *Mixing, *Model studies, Arkansas, Thermal power plants, Nuclear power plants, Thermal pollution, Path of pollutants, Mathematical models, Hydraulic models, Diffusion, Turbulence, Jets.

The results are summarized of the analytical and thermal-hydraulic model investigations that were carried out to determine whether the plant heat load from an 850 megawatt nuclear power plant could be dissipated in Dardanelle Reservoir under Arkansas state-prescribed criteria and limitations. Based on the results of the analytical and thermal-hydraulic model investigations, it was shown that the plant heat load of $137.1 \times 10^6 \text{ Btu/day}$ can be dissipated in the reservoir. The analytical procedure employed yielded conservative temperature distribution patterns throughout the reservoir and demonstrated its potential, both as a basis for evaluation of thermal effects and as a tool for future refinement and development. The analytical procedure used was based on a turbulent-mixing mathematical model of a non-buoyant jet with an isothermal temperature. The results of the hydraulic and mathematical model studies were similar. Intake temperature was raised only about 1 deg F under critical conditions. (Novotny-Vanderbilt)

EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS.

Technische Hochschule, Aachen (West Germany).

For primary bibliographic entry see Field 05C.

W70-03547

THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 05C.
W70-03550

EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE,

Battelle-Northwest, Richland, Wash.

L. L. Ames.

Available from the Clearinghouse as PB-189 405, \$3.00 in paper copy, \$0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-8, Cincinnati, Ohio, Mar 1969. 33 p, 17 fig, 5 tab, 19 ref. FWPCA Program 17010, Contract No 14-12-413.

Descriptors: *Filtration, *Tertiary treatment, *Phosphates, Sewage treatment, Nutrients, Separation techniques, Adsorption, Anion adsorption, Cation adsorption, Surfaces.

Identifiers: Phosphate removal, Alumina.

A synthetic secondary sewage effluent containing 10 to 30 mg/liter phosphate, 300 mg/liter bicarbonate, 112 mg/liter Cl and 50 mg/liter sulfate as anions and 130 mg/liter Na, 60 mg/liter Ca, 25 mg/liter each of K and Mg and 20 mg/liter ammonium as cations was used with 7.6 ml alumina columns to study the effects of various compositional changes on phosphorus removal. The phosphorus capacity was about half for the solution containing no Ca or Mg as compared to solutions containing them. Probably adsorption onto the alumina occurs partly as a calcium or magnesium phosphorus complex rather than as a simple phosphorus anion. Increasing the competing sulfate concentration in the influent solution to 4800 mg/liter showed little effect on phosphorus adsorption. Raising the pH of the synthetic sewage effluent to greater than 8.0 led to precipitation of calcium carbonate on the alumina grains which progressively lowered alumina phosphorus capacity. This problem was not encountered when using actual sewage effluent. It was found that alumina columns could be satisfactorily regenerated with NaOH. (Knapp-USGS)
W70-03612

OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,

Kansas Water Resources Research Inst., Manhattan.

L. E. Erickson, and L. T. Fan.

Project Completion Report, (1969). 5 p, 8 ref, 2 append. OWRR Project No A-019-KAN.

Descriptors: *Activated sludge, *Hydraulic regime, *Mathematical modeling, *Optimization, *Mixing, Analysis, Design.

Identifiers: *Step aeration, Biological waste treatment.

This report summarizes work completed under a two year project on the optimization of step aeration waste treatment systems. Mathematical models of several step aeration systems were developed, process optimization studies were conducted, and the optimal step aeration and conventional treatment processes were compared.

W70-03614

SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES,
Nebraska Univ., Lincoln. Water Resources Research Inst.
For primary bibliographic entry see Field 03A.
W70-03646

5E. Ultimate Disposal of Wastes

ESTABLISHMENT OF TOWN SANITARY DISTRICTS.

Wis Stat Ann secs 60.305-60.315 (1957), as amended, (Supp 1969) 60.316 (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Water works, *Waste disposal, Domestic wastes, Sewers, Sewage treatment, Sewage disposal, Storm drains, Surface drainage, Algal control, Aquatic life, Water conservation, Public health, Water pollution, Contracts, Regulation, Right-of-way, Estimated costs, Legal aspects, Legislation, Sewage districts.

The town sanitary district commissions are required to project, plan, construct, and maintain systems of water works and garbage or refuse disposal, including sanitary sewers, surface sewers, or storm water sewers. They are authorized to provide for sewage collection and the chemical treatment of water for control of nuisance producing aquatic growths. They are to undertake improvements for the promotion of public health. They may require the installation of private sewage systems. Charges for services and methods of financing construction are discussed. The Department of Resource Development may establish town sanitary districts in areas where it finds existing facilities inadequate and where a menace to health or pollution of surface waters exists. This determination by the Department is subject to judicial review. (Duss-Florida)
W70-03344

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4,

American Water Works Association, New York.

Harry A. Faber, and Kitty C. Klomp.

Journal of American Water Works Association, Vol 62, No 1, p 63-70, Jan 1970. 8 p, 113 ref. FWPCA Grant 12120.

Descriptors: *Waste disposal, *Water treatment, Waste dilution, Disposal, Mixing, Waste treatment, Water quality control, Water pollution control, Treatment facilities, Separation techniques.

Identifiers: Water treatment plant wastes.

Current information on the nature of the water treatment plant waste disposal problem is summarized to assist water utilities in solving the problem. Technology presently available is described, new approaches to the problem are discussed and future directions for the coordination and dissemination of information are suggested. (Knapp-USGS)
W70-03442

EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE,

Battelle-Northwest, Richland, Wash.

For primary bibliographic entry see Field 05D.
W70-03612

5F. Water Treatment and Quality Alteration

RESEARCH ON TASTES AND ODORS,

A. A. Rosen.

Journal of American Water Works Association, Vol 62, No 1, p 59-62, Jan 1970. 4 p, 3 fig, 30 ref.

Descriptors: *Water quality, *Odor, *Taste, Biological properties, Potable water, Water pollu-

tion effects, Water properties, Laboratory tests, Water chemistry.

Identifiers: Water odor testing, Water taste testing.

Essentially all research on taste and odor in water is centered on the problems of odor. The most important progress has been made in the development of investigational techniques in an understanding of the role of specific industrial and natural organic chemicals in causing objectionable odors in water. Two of the most important natural odorants, metabolites of microorganisms, have been isolated and identified, or at least characterized in great detail. This identification is leading to more systematic water treatment, consisting of the use of tailor-made processes for the removal of specific odor contaminants. Sensory methods for the measurement and characterization of water odors are less actively investigated and have made relatively little progress in recent years. (Knapp-USGS)
W70-03440

HEALTH: WATER, SEWAGE, GARBAGE.

SC Code Ann secs 32-1201 thru 32-1335 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Sewage, *Septic tanks, *Water pollution, Water supply, Watershed management, Water sources, Environmental sanitation, Sewage disposal, Sanitary engineering, Streams, Waste disposal, Local governments, Administrative agencies, Water quality control, Inspection, Water pollution sources, Potable water, Domestic wastes, Structural design, Permits, Construction, Maintenance, Legislation, Legal aspects, Regulation, Watersheds (Basins).

Identifiers: *Garbage disposal, *Penalties (Criminal), *Privies.

To insure compliance with established water quality standards, all public or quasi-public water supplies must be periodically analyzed and the results reported to the State Board of Health. The Board shall also examine and inspect watersheds and water supplies and may publicize their findings. Construction permits issued by the Board are required for construction or modification of any public water treatment facilities or distribution systems. Provisions are made for protecting the water supply and regulating the sewer systems of Greenville County. The location and sanitation of privies located on watersheds of public water supplies are restricted. Manufacturing concerns which provide housing for their employees must include adequate sewage closet facilities. Requirements and regulations are established for the use of septic tanks in counties having cities with a population of seventy thousand or more. Special regulations are provided for septic tanks, garbage disposal, plumbing, sewage disposal, and the like on Pawley's Island and in Spartanburg County. Special permits are required for constructing or servicing any septic tank or other sewage disposal systems in Aiken County. (Dearing-Florida)
W70-03629

HEALTH: WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE).

SC Code Ann secs 32-1201 thru 32-1213 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Water supply, *Water works, *Water pollution, Water treatment, Water storage, Water distribution, Public health, Potable water, Permits, Administrative agencies, Standards, Engineering, Inspection, Bacteria, Chemical analysis, Water analysis, Testing, Water sources, Watershed management, Water pollution sources, Water conveyance, Dams, Legal aspects, Legislation, Regulation.

Identifiers: *Penalties (Criminal).

Permits from the State Board of Health are required for construction or modification of any

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5F—Water Treatment and Quality Alteration

public or semi-public water treatment facility or water distribution system. The Board shall establish regulations and standards for the operation of waterworks systems and must inspect and approve any such facility before it begins operation. All public and semi-public water systems must be maintained in compliance with bacteriological and chemical water quality standards established by the Board. Every such water supply shall be periodically tested by the Board. The Board may enter and inspect all watersheds and water systems and may publish its findings. It is unlawful to: (1) trespass upon or deposit excreta in any source of public water supply or on the watershed of Greenville; (2) camp, hunt, fish, bathe, or wash in these sources or this watershed; (3) pasture any pigs or hogs or leave the carcass of any dead bird or animal on this watershed; (4) stop any vehicle unnecessarily or deposit any matter on any road within this watershed; or (5) destroy any water conductor of the Greenville water supply. Penalties are provided for failure to comply with these provisions. (Dearing-Florida)
W70-03630

HEALTH: WATER, SEWAGE, GARBAGE (PRIVIES, SEWAGE SYSTEMS, SEPTIC TANKS).

SC Code Ann secs 32-1221 thru 32-1270 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Septic tanks, *Watersheds (Basins), *Water sources, Environmental sanitation, Administrative agencies, Domestic wastes, Sewage disposal, Inspection, Legal aspects, Sewage, Construction, Installation, Maintenance, Engineering, Storage capacity, Structural design, Sanitary engineering, Waste water disposal, Effluents, Construction materials, Streams, Discharge, Pipes, Legislation.
Identifiers: Water closets.

All privies located on the watershed of any public surface water supply or within a specified distance from any house must be sanitarily maintained by designated persons in the manner prescribed by the State Board of Health. Sanitation inspectors designated by the Board may enter any premises for the purposes of inspection and may close any privy improperly maintained or constructed. Housing furnished to manufacturing employees by their employers must include properly constructed and maintained sewage closets. Sanitation of these closets and sewage connections is supervised by the Board. The State Board of Health shall establish specifications for septic tanks in counties which contain cities with a population greater than seventy thousand. These specifications shall incorporate statutory standards as to size, shape, liquid capacity, liquid depth, and detention period. Tanks with a capacity of one thousand gallons must be approved by the county health officer. Further regulations concern installation, construction materials, use of grease traps, distribution pipes and temporary tanks. No septic tank effluent may be discharged into any stream without approval from the county health officer. Penalties are provided for noncompliance with these provisions. (Dearing-Florida)
W70-03631

HEALTH: WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY).

SC Code Ann secs 32-1272 thru 32-1335 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Septic tanks, *Sewage disposal, *Domestic wastes, Permits, Administrative agencies, Construction, Sanitary engineering, Maintenance, Waste disposal, Water pollution sources, Streams, Rivers, Oceans, Construction materials, Tile drains, Plumbing, Potable water, Inspection, Warning systems, Legal aspects, Sewers, Water quality, Water quality control, Legislation.
Identifiers: *Toilets, *Tile fields, *Urinals, Slop sinks.

No person may install or service a septic tank or other sewage disposal system in Aiken County without a permit from the governing body of that county. General regulations for garbage collection and disposal are provided. The State Board of Health shall regulate all sewers and septic tanks on Pawley's Island. No garbage, raw sewage, or drainage from any tile field may be deposited or discharged into the ocean, creeks, rivers, or marshes in the Pawley's Island area. All hotels, restaurants, inns, and boarding houses must provide safe drinking water and proper toilet facilities. Warning signs placed on unsafe facilities may not be tampered with. Adequate sewage facilities must be installed on premises where people reside or are employed in Greenville County. The Spartanburg County Board of Health shall regulate the quality of water supplies, sewage and garbage disposal, and commercial septic cleaning service in that county. The County Board shall require licenses for garbage collection and commercial septic tank services. (Dearing-Florida)
W70-03632

5G. Water Quality Control

THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,

Puerto Rico Univ., Mayaguez. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04A.
W70-03246

POSSIBILITIES FOR MINERALIZATION OF PESTICIDES (DUTCH),

J. K. Baars.
H2O, Vol 2, No 17, p 398-39, Aug 21, 1969. 2 p, 1 fig, 1 tab.

Descriptors: *Pesticide residues, *Pesticide Kinetics, *Adsorption, Path of pollutants, Pesticide toxicity, Translocation, Biodegradation, Pesticide removal, Water quality control.
Identifiers: Mineralization of pesticides.

The increasing use of pesticides with a high persistence under natural conditions creates a problem with great consequences. Although these components may disappear from their dissolved state for example by adsorption to river mud or accumulation in vegetable material or animal tissue, it does not mean a general decrease in concentration. Only complete mineralization would really mean elimination. The molecular structure is the reason of this high persistence. Chlorinated hydrocarbons, such as aldrin, hexachlor, dieldrin, heptachlorepoxyde are an example of this. Compounds like parathion and diuron, although very toxic, can be considered as rather soft. The chlorinated compounds cannot be mineralized aerobically. Recently it has been shown that some of them can be broken down anaerobically. Persistent also under anaerobic conditions, were heptachlorepoxyde and dieldrin. The consequence of this is the necessity of research for substitutes that are degradable, which also gave the solution in the case of the hard detergents. (Knapp-USGS)
W70-03271

CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE,

Wisconsin Univ., Madison. Dept. of Botany.
George P. Fitzgerald, and Folke Skoog.
Sewage and Industrial Wastes, Vol 26, No 9, p 1136-1140, Sept 1954. 1 fig, 1 ref.

Descriptors: *Algicides, *Cyanophyta, *Eutrophication, Wisconsin, Water quality control, Lakes, Water pollution sources, Chlorophyta, Nuisance algae, Fish, Zooplankton, Snails, Application methods.
Identifiers: *2,3-dichloronaphthoquinone, Microcystis, Aphanizomenon, Anabaena, Glocotrichia, Janesville (Wis), Spaulding's Pond (Wis), Hydrodictyon, Najas, Anacharis, Lake Waubesa (Wis), Macrophytes, Algal growth.

Methods for application of the selective algicide, 2,3-dichloronaphthoquinone (2,3-CNQ), and results of a large-scale test of its effectiveness in controlling excessive growths of cyanophytes (blue-green algae) in Spaulding's Pond, Wisconsin, are reported. This highly eutrophic lake of 27 acres normally supports a continuous bloom of algae, principally *Microcystis* and *Aphanizomenon*, during summer. Spray applications of 2,3-CNQ suspensions, yielding concentrations of 30-55 parts per billion in the lake, clumped and killed heavy growths of cyanophytes. Such chemical treatment had no observable harmful effects on chlorophytes (green algae), higher aquatic plants, fish, or zooplankton. Some instances of rapidly recurring cyanophyte blooms required repeated applications. Lasting effects of treatment with 2,3-CNQ may be indirectly increased as a result of vigorous growth of chlorophytes and macrophytes which follows suppression of cyanophytes. (Eichhorn-Wisconsin)
W70-03310

PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES.

Wis Stat Ann secs 144.21-144.30 (Supp 1969).

Descriptors: *Wisconsin, *Treatment facilities, *Pollution abatement, *Project planning, Administrative agencies, Water pollution control, Water conservation, Natural resources, Wildlife conservation, Public health, Shoreline cover, Cities, Navigable waters, Lakes, Lake Superior, Lake Michigan, Fish, Aquatic animals, Environmental sanitation, Rivers, Domestic wastes, Standards, Regulation, Waste disposal, Financing, Beds, Waste treatment, Water treatment, Water quality, Water utilization.
Identifiers: *Air contaminant, *Emission.

A state program is created for financial assistance to municipalities in the construction of pollution prevention and abatement facilities. The types of activities to be financed by the program include preliminary planning, actual construction, and supervision of the anti-pollution facilities. Methods of financing and cost sharing between the state and municipalities are outlined. The Department of Resource Development, in cooperation with an advisory subcommittee and municipalities, is empowered to protect navigable waters. This plan is designed to promote healthful conditions, to prevent and control water pollution, to protect spawning grounds and aquatic life, to control placement of structures and land uses, and to preserve shore cover and natural beauty. The Department is to prepare a comprehensive plan to guide municipalities in regulating navigable waters and adjacent shorelands. Water use priorities governing the plan are listed in the statute. 'Solid waste' is defined to include garbage, refuse, and other discarded or salvageable solid materials; the term does not include solids or waste materials in waste water effluents or other common water pollutants. (Duss-Florida)
W70-03345

FOAM SEPARATION OF KRAFT PULPING WASTES.

Georgia Kraft Co., Rome. Research and Development Center.
For primary bibliographic entry see Field 05D.
W70-03350

NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA,

North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 05A.
W70-03351

FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS,

Wisconsin Univ., Madison. Water Resources Center.

For primary bibliographic entry see Field 05D.
W70-03353

CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION.

Chem Eng News, Vol 47, No 38, p 58-69, Sept 1969. 12 p.

Descriptors: *Environment, *Water pollution, *Cleaning, *Pollution abatement, Water pollution, Air pollution, Pesticides, Air pollution effects, Pollutants, Water pollution effects, Water pollution sources, Chemical engineering, Chemistry, Motor vehicles, Municipal wastes, Tertiary treatment, Public health, Solid wastes, Contamination, Ecology.

Identifiers: *Air pollution control, *Pollution control.

A summary and recommendations from the report of the subcommittee on environmental improvement of the ACS Committee on Chemistry and Public Affairs, presented at the American Chemical Society national meeting in New York City in Sept 1969, are given. The subcommittee had 2 goals: (1) to give an objective account of the current status of the science and technology of environmental improvement—what is known, how it is being used, what must be learned, and how it might be used; and (2) to analyze the information and recommend measures that, if adopted, should help to accelerate the sound development and use of that science and technology. A strong emphasis is placed on chemistry, chemical engineering, and the related disciplines. The full report contains 73 recommendations found in 4 principal divisions of the report: air environment, water environment, solid wastes, and pesticides in the environment. (USBR)
W70-03364

REPORT OF COMMITTEE ON POLLUTION.

Proceedings of the 56th Annual Convention Nat'l Rivers and Harbors Congress, p 8-13, May 13-15 1969. 6 p.

Descriptors: *Water pollution control, *Financing, *River basins, *Education, Water pollution, Water policy, Water quality, Water quality control, Water pollution sources, Pollution abatement, Pollutant identification, Pollutants, Salivation, Administrative agencies, Regulation, Waste treatment, Treatment facilities, Sedimentation, Sediments, Erosion, Erosion control, Coordination, River basin development.

Identifiers: National Rivers and Harbors Congress.

The general breakdown in pollution control appears to be lack of adequate funding at local, state, and federal levels. More public education concerning pollution is needed. Water storage for pollution abatement should be given the same weight in evaluation as other uses. A river basin approach to total problem solution is generally a sound basis of operation. The salivation problem should attract cooperation and support from more than just agricultural agencies. At this time the application of existing research results is more needed than additional research. A public information and education program should be a first priority. The water quality management program should use locally-oriented, cooperative efforts governed by standardized state and federal regulations. Land management practices should benefit soil conservation as well as water quality control. Approved standards must be implemented in water quality and quantity control measures. A lack of awareness, a poor attitude, and apathy are the greatest deterrents to pollution control. Erosion and other sediment sources are a major source of pollution and must be controlled. (Smith-Florida)
W70-03378

ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION--IN-

FORMATION CENTER.

Conservation Foundation Letter 9-69, p 1-11, Sept 30, 1969.

Descriptors: *Conservation, *Conferences, *Legal aspects, Public rights, Publications, Competing uses, Condemnation, Eminent domain, Legislation, Water conservation, Resources, Pollution abatement, Air pollution, Water pollution, Water pollution control, Water pollution effects, Cost-benefit ratio, Cost allocation.

A conference on law and environment in September, 1969, considered problems concerning the preservation of environment. Recommendations made to help the legal profession become more involved in the struggle for environmental quality included: (1) creation of an environmental law center and environmental law publication; (2) expansion of law school programs in environmental law; and (3) the encouragement by bar associations of greater interest in environmental law. Legal methods of eliminating influences destructive to the environment include abatement of nuisances and the use of the trust doctrine, which impresses a trust upon the state to preserve public and private lands for the benefit of the public. The opinion was expressed that the courts are ahead of legislatures in solving environmental problems. The difficulties previously encountered by private citizens in establishing standing in court to challenge public officials were said to be lessening. Other problems of private litigation discussed included the burden of proving environmental damage, the social utility of litigation, and expenses of suit. A specific topic discussed was the Santa Barbara oil spill. Expense of private suits in such cases was decided to the prohibitively high. (Dye-Florida)
W70-03379

LAND AND WATER CONSERVATION FUND ACT.

For primary bibliographic entry see Field 06B.
W70-03390

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR).

For primary bibliographic entry see Field 06B.
W70-03391

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE).

For primary bibliographic entry see Field 06B.
W70-03392

LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS).

For primary bibliographic entry see Field 06B.
W70-03394

POWERS OF THE WATER POLLUTION CONTROL BOARD.

Ohio Rev Code Ann secs 6111.01 thru 6111.05, 6111.07, 6111.08 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Water pollution, *Water pollution control, *Sanitary engineering, Legislation, Legal aspects, Sewage, Sewage disposal, Domestic wastes, Industrial wastes, Municipal wastes, Water resources development, Streams, Rivers, Lakes, Drainage, Drainage districts, Water pollution treatment, Pollution abatement, Public health, Waste treatment, Waste disposal, Federal government, State governments, Administrative agencies.

A Water Pollution Control Board is established within the Department of Health for the prevention, control, and abatement of water pollution. The Board is granted the power: to develop plans;

to conduct research; to join in cooperative programs with other concerned agencies; to promulgate rules and regulations; to issue, revoke, or modify permits for the discharge of sewage and wastes; and to exercise all other incidental powers necessary to carry out the purposes of water pollution control. Pollution of the waters of the state is prohibited unless a permit is obtained from the Board. Procedures are established for the prosecution of violators. (Casey-Florida)
W70-03398

THE ORGANIZATION, PURPOSES, AND POWERS OF A SANITARY DISTRICT.

Ohio Rev Code Ann secs 6115.04, 6115.05, 6115.16 thru 6115.19 (Page 1953).

Descriptors: *Ohio, *Environmental sanitation, *Water policy, *Water supply, Legislation, Legal aspects, Water resources, Water pollution, Water resources development, Mosquitoes, Insect control, Domestic wastes, Public health, Streams, Sewage, Sewage districts, Streamflow, Channels, Construction, Watercourses, Drainage, Water purification, Taxes.

Upon petition in the manner prescribed by this statute, the court of common pleas of any county may establish within that county a sanitary district to prevent and control pollution, to regulate the flow of streams and channels for sanitary purposes, to provide for collection and disposal of sewage, garbage and other refuse, to provide a water supply, and to exterminate insects and destroy their breeding places. The board of directors of a sanitary district must secure approval of plans for improvement of the district. The board is authorized to enter upon private lands to carry out the purposes of the district. The board is not authorized to construct sewer systems for local service, but is limited to construction and maintenance of works necessary to improve district sanitation and water supply. (Casey-Florida)
W70-03399

DUTIES OF SANITARY DISTRICTS REGARDING POLLUTION, WATER SUPPLY, MOSQUITO CONTROL, AND INVESTIGATIONS OF RAINFALL AND STREAMFLOW.

Ohio Rev Code Ann secs 6115.23, 6115.24, 6115.26, 6115.27 (Page 1953).

Descriptors: *Ohio, *Environmental sanitation, *Water policy, *Water supply, Legislation, Legal aspects, Water resources, Sewage, Sewage districts, Water pollution, Water pollution control, Water utilization, Wastes, Mosquitoes, Public health, Federal government, Sewers, Streamflow, Rainfall, Drainage, Conservation, Water resources development, Insect control.

Authority is granted to the board of directors of each sanitary district to make and enforce regulations within the district regarding the design, construction and use of sewers; the uses and distribution of the water supply; the prevention of pollution or unnecessary waste of the water supply; the making of surveys and investigations of rainfall and streamflow; and the control, prevention, and elimination of mosquitoes and other insects, and their breeding places. Authority to cooperate with the federal government, the state government, and their agencies for these purposes is granted. Penalties for noncompliance with these regulations are established. (Casey-Florida)
W70-03400

WATERCRAFT; NAVIGATION.

For primary bibliographic entry see Field 06E.
W70-03408

OHIO VALLEY SANITATION COMPACT.

Tenn Code Ann secs 70-401 thru 70-409 (1956).

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Descriptors: *Tennessee, *Interstate compacts, *River basin development, *Ohio River, Interstate rivers, Rivers, Streams, River basins, River basin commissions, Basins, Water resources development, Interstate commissions, Legislation, State governments, Administrative agencies, Navigable waters, Pollution abatement, Water pollution control, Standards, Water pollution treatment, Water pollution sources, Water pollution, Waste water treatment, Industrial wastes, Sewage.

The Governor is authorized to join the Ohio River Valley Water Sanitation Compact. The party states agree to cooperate in pollution control and abatement, to enact any legislation necessary for such purpose, and to maintain the Ohio River Basin's waters in a satisfactory sanitary condition. The Ohio River Valley Water Sanitation Commission and District are hereby created. It is recognized that no single standard for sewage treatment is applicable to all parts of the district, but pollution by sewage or industrial wastes shall not injuriously affect the various uses of the interstate waters of the basin. All sewage discharged into the basin shall be treated so as to remove all settleable solids and not less than forty-five percent of all suspended solids. All industrial wastes discharged into the basin shall be treated so as to protect the public health and preserve the waters for other legitimate purposes. The Commission may adopt regulations and standards for enforcing this article. The Commission shall make studies and recommendations to the party states. The Commission may order that the discharge of sewage or industrial wastes into interstate rivers be discontinued, modified or treated. (Smith-Florida)
W70-03415

TENNESSEE RIVER BASIN POLLUTION CONTROL.

Tenn Code Ann secs 70-1901 thru 70-1912 (Supp 1969).

Descriptors: *Tennessee, *Interstate compacts, *Water pollution, *Tennessee River, Interstate rivers, Legislation, Administrative agencies, Interstate commissions, River basin commissions, State governments, Pollution abatement, Water quality control, Standards, Sewage treatment, Waste treatment, Water utilization, Classification, Sewage, Industrial wastes, Judicial decisions, Administrative decisions, Financing.
Identifiers: *Tennessee River Basin.

The Tennessee River Basin Water Pollution Control Compact provides for the control and reduction of pollution in that area. A Commission is established to administer the Compact as an agency of each participating state. The Commission shall conduct surveys and make recommendations to the signatory states. Membership, administrative procedure, powers to deal with property, and the method of financing the Commission are provided. No single standard of sewage and waste treatment and no single standard of quality of receiving waters shall apply throughout the district. The standards established should reflect the present and proposed highest use of the waters. The Commission may establish interstate water quality standards for various classifications of use. Each signatory state will classify waters within its state upon approval by the Commission, and will establish programs for treatment of sewage and industrial wastes in accordance with these standards. The Commission, after investigation, notice and hearing, may recommend abatement action against reported polluters and may order polluting discharge by any municipality, corporation, person, or other entity to be discontinued. Any court of competent jurisdiction shall exercise its equitable powers to enforce and/or modify the order. (Dearing-Florida)
W70-03420

ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,

California Univ., Berkeley. Sanitary Engineering Research Lab.

P. H. McGauhey, Jona Bargur, E. M. Lofting, and H. C. Davis.

Available from the Clearinghouse as PB-189 169, \$3.00 in paper copy, \$0.65 in microfiche. SERL Report No 69-8, Nov 1969. 117 p, 45 tab, 44 ref. FWPCA Program 16090DLU, (WP-00597-06).

Descriptors: *Economic evaluation, *Water quality, *Computer programs, Estuaries, *Input-output analysis, San Francisco Bay, *Mathematical models, Waste water treatment.

Identifiers: Water quality standards, *Systems analysis, Industrial effluents, Water management.

The tendency to set quality of the water resource rather than quality of discharges as the objective of environmental control makes it necessary to develop some relationship between concentration of individual pollutants in the resource and in the discharge in terms of characteristics of the receiving estuary. Moreover, the growing percentage of the water resource which is degraded in quality through beneficial use together with the increasing investment necessary to restore water quality, makes it important to minimize the cost of achieving water quality objectives. The study makes use of modern mathematical models, programming techniques, and input-output analysis to optimize quality control systems; and illustrates the use of the models by examples drawn from San Francisco Bay data and quality requirements.
W70-03428

POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION: GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS,

North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.

R. B. Phillips, A. J. Kobayashi, W. Brown, and V. T. Stannett.

Available from the Clearinghouse as PB-189 292, \$3.00 in paper copy, \$0.65 in microfiche. Progress Report No 25, Water Resources Research Institute of The University of North Carolina, Jan 1970. 60 p. OWRR Project A-032-NC.

Descriptors: *Pulp wastes, *Lignins, *Industrial wastes, Water pollution control non-structural alternatives.

The problem of increased utilization of lignin has been approached from two directions: first, a procedure has been developed for grafting vinyl monomers to isolated lignin; second, grafting of hydrophilic monomers to pulps containing substantial amounts of lignin (high yield pulps) has been attempted. In the first case, styrene was successfully grafted by radiation to a commercially available lignin. In the more successful cases, the grafted product has the solubility behavior of polystyrene. While the reaction proceeds adequately in the presence of good swelling agents for the lignin, the expenditure of radiation is great (16 x 10 to the 6th power rads); on the other hand, grafting in the presence of large amounts of methanol speeds the reaction (3 x 4 x 10 to the 6th power rads), presumably because of a hindered radical termination rate. It was found that acrylamide could not be significantly grafted to unbleached kraft pulps containing even only 4% lignin. Consequently, a study was made of the strength properties of blends of highly grafted pure cellulose pulps and the ungrafted high yield kraft pulps. While the blends significantly improved the strength properties of the high yield pulp, the radiation involved and the amounts of the grafted pulp required were great, thus casting doubt on the economic feasibility of such a combination. (Howells-University of North Carolina)
W70-03438

PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL.

North Carolina Water Resources Research Inst., Raleigh; North Carolina State Univ., Raleigh; and North Carolina Univ., Chapel Hill.

Available from the Clearinghouse as PB-189 289, \$3.00 in paper copy, \$0.65 in microfiche. Report No 30, David H. Howells, (Ed), Water Resources Research Institute of The University of North Carolina, Oct 1, 1969. 120 p. OWRR Project A-999-NC.

Descriptors: *Municipal water, *Municipal wastes, *Industrial wastes, *Water rates, *Water pricing, Water demand, Water pollution control.
Identifiers: Sewer rates.

The objectives of this workshop were to: (1) assess current practices in setting water and sewer charges together with possible alternatives, (2) examine present and future objectives of municipal government in establishing water and sewer service charges, (3) consider the effect of water and sewer service charges on water use and waste disposal practices, and (4) review and discuss proposed research and extension activities related to water and sewer service charges. Participants included public works officials of North Carolina's larger cities, consulting engineers, university faculty and other interested persons. This is the third in a series of research workshops sponsored by the Institute to increase the communication between research users and researchers on water resource problems and research needs.
W70-03439

WATER AND MAN: A WORLD VIEW,

Geological Survey, Washington, D.C. Water Resources Div.

For primary bibliographic entry see Field 06G.

W70-03450

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES,

Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.

For primary bibliographic entry see Field 05B.

W70-03488

VACATION OR RELOCATION OF WATER-COURSES - CONSTRUCTION OF DAMS.

For primary bibliographic entry see Field 04A.

W70-03521

ACQUISITION OF LAND TO PREVENT CONTAMINATION.

Pa Stat Ann tit 53, sec 2992 (1957).

Descriptors: *Pennsylvania, *Condemnation, *Compensation, *Domestic water, Water pollution, Reservoirs, Pollution abatement, Cost repayment, Condemnation value, Public health, Water conservation, Streams, Local governments, Cities, Safety, Water quality, Legislation, Damages.

Any municipality, except third class cities, may acquire and hold lands which are contiguous to streams or reservoirs from which water is taken for public use when it is necessary to preserve the reservoirs from contamination. These lands may be acquired by purchase or condemnation. No land, however, shall be taken until just compensation has been made for property taken, injured, or destroyed. (Schram-Florida)
W70-03532

AUTHORITY OF CITIES TO DEVELOP SEWAGE SYSTEMS, AND TO IMPROVE LAKES AND WATERCOURSES.

Wis Stat Ann secs 62.18, 62.22 (1) (3), 62.23 (18) (1957).

Descriptors: *Wisconsin, *Cities, *Lake Michigan, *Riparian rights, Legislation, Legal aspects, Sewage treatment, Environmental sanitation, Waste treatment, Construction, Taxes, Government finance, Municipal waste, Lakes, Rivers, Streams, Navigable waters, Navigation, Natural resources, Public health, Condemnation, Sewage districts, Sewers.

Water Quality Control—Group 5G

Cities are given the authority to construct, maintain, and improve systems of sewerage, including sewage disposal plants, and may join in cooperative efforts with adjacent municipalities of a bordering state in these endeavors. Authority for surveys, plans, and construction of sewers and sewer districts is provided. A special sewer district tax power to finance these projects is granted. A city may take or destroy any riparian rights appurtenant to land abutting Lake Michigan whenever necessary for a public improvement. A city may improve lakes, rivers, and other navigable streams, where such improvements are in aid of navigation, or are for protection of public health and welfare, or wildlife. (Casey-Florida)

W70-03534

WATERWORKS AND SEWERAGE.

Wis Stat Ann secs 145.04 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Sewage disposal, *Municipal wastes, *Public health, Cities, Sewage, Waste water disposal, Water supply, Water tanks, Waterworks, Pipes, Plumbing, Inspection, Regulation, Utilities, Leakage, Buildings, Standards, Permits, Administrative agencies, State governments. Identifiers: *Sanitary district.

Townships, counties, metropolitan sewerage commissions and certain cities may prescribe ordinances concerning waterworks and sewerage in order to safeguard public health. These are not to conflict with minimum standards for pipes, tanks, and fixtures by which fresh water, waste water, or sewage is carried. No such waterworks are to be placed in buildings except in accordance with plans approved by the Board of Public Works or Board of Health. No plumbing shall be done, except repairing leaks, without permit. No municipal sewerage commission or other agency shall require licensing of anyone licensed under this chapter or prohibit such person from doing business within the scope of his permit. Authorities of sewerage districts shall report the failure of any licensed plumber to qualify as a journeyman or master plumber to the State Board of Health. (Duss-Florida)

W70-03535

STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR,

Oregon State Univ., Corvallis.

For primary bibliographic entry see Field 08B.

W70-03543

MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

For primary bibliographic entry see Field 08B.

W70-03544

JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY,

Chalmers Univ. of Technology, Goteborg (Sweden). Hydraulics Div.

For primary bibliographic entry see Field 08B.

W70-03555

LEGAL VIEWPOINT (WATER STANDARDS),

Frank E. Maloney.

Am Water Works Ass'n J, Vol 52, No 9, p 1180-88, Sept 1960. 9 p, 61 ref.

Descriptors: *Potable water, *Water policy, *Public health, *Water quality, Standards, Impaired water quality, Domestic water, Water law, Water quality control, Water supply, Florida, Cities, Administrative agencies, Federal government, Fluoridation, Water purification, Wastes, Water pollution, Water Quality Act, Legislation, Water requirements, Water treatment, Industrial use, Water works.

Identifiers: *Water quality standards.

Due to the endorsement by so many national organizations concerned with water supply and public health, the Drinking Water Standards of the USPHS have had a tremendous impact throughout the United States. Public health legislation, under the police power, has been enacted in many states with the USPHS standards serving as guidelines. State boards of health have been generally utilized for implementing and maintaining these standards. Municipal corporations may also enact ordinances relating to water supply and purity. Generally, the courts have upheld these delegations of power when they are necessary for the protection of public health. Although the greatest area of litigation in this field has been with respect to fluoridation, no court has thus far prohibited it. Complying with the USPHS standards could be an effective means for minimizing the liability of water purveyors for negligence. Developments in the area of implied warranty suggest that liability may be extended to include water suppliers. A brief review of the law in these areas is included. Widespread respect for the USPHS standards seems to dictate that any drastic change be limited to prohibiting contaminants which can clearly be shown to pose a threat to the public health. (Schram-Florida)

W70-03561

OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION).

For primary bibliographic entry see Field 04A.

W70-03564

WATER DEVELOPMENT AUTHORITY.

For primary bibliographic entry see Field 06B.

W70-03575

WATER AND WATERWORKS COMPANIES.

For primary bibliographic entry see Field 06E.

W70-03587

MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,

General American Transportation Corp., Niles, Ill. G. J. Ducar, and P. Levin.

Available from the Clearinghouse as PB 189 295, \$3.00 in paper copy, and \$0.65 in microfiche. FWPCA Ohio Basin Region, Robert A. Taft Water Research Center, Report TWRC-10, Advanced Waste Treatment Research Laboratory, Cincinnati, Ohio - Sept 1969. 72 p, 4 tab, 32 fig, 57 ref. FWPCA Program 17090; FWPCA Contract 14-12-415.

Descriptors: *Mathematical models, Computer models, *Sewage sludge, Incineration, Sludge disposal, Evaluation, *Capital costs, *Operating costs, *Maintenance costs.

Identifiers: Fluidized bed incineration.

The development of a computer program to evaluate sewage sludge fluidized bed incineration systems is described. Data for the program was collected from manufacturers, a literature survey and field trips to operating installations. Most of the data was obtained from the field because of the lack of available information from the other sources. More than fifty correlation relationships were attempted before the necessary data could be reasonably represented. Equations were developed for the least square curves which fitted the data best. These equations were used as the basis for the computer program developed to size some of the major components and to estimate capital, operating and maintenance costs for the fluidized bed incineration system.

W70-03610

OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,

Kansas Water Resources Research Inst., Manhattan.

For primary bibliographic entry see Field 05D.

W70-03614

AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, Clemson Univ., S.C. Dept. of Environmental Systems Engineering.

Benjamin C. Dysart, III.

Paper presented at 24th Purdue Ind Waste Conf, Purdue Univ, May 6-8, 1969. 24 p, 12 fig.

Descriptors: *Industrial wastes, *Economic efficiency, *Resource allocation, *Dynamic programming, *Water quality control, Dissolved oxygen, Planning, Management, Water utilization, Streams, Constraints, River basins.

Identifiers: Industrialized basin.

An economic approach to regional industrial waste management was presented. Two problem levels were considered; a resource allocation problem for which waste assimilative capacity was allocated to among competing users and the objective was economic efficiency with dissolved oxygen standards (DO) as constraints. The second problem level consisted of investigating the response on sensitivity of the minimum total system cost and the optimal management policy to system variation. A hypothetical river basin system consisting of three stream reaches or stages in series with an industrial waste outfall located at the upstream end of each stage was used to illustrate the two problem levels. A dynamic programming technique was found to be useful in determining the minimum-cost management systems that met all constraints for a fixed system configuration. (Thiuri-Cornell)

W70-03619

AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN,

Crown Zellerbach Corp., Camas, Wash.

H. R. Amberg, D. W. Wise, and T. R. Aspitarte. Tappi (Technical Association of Pulp and Paper Industry), Vol 52, No 10, p 1866-71, Oct 1969. 6 tab, 5 fig, 7 ref.

Descriptors: *Aeration, *Dissolved oxygen, *Oxygen, Water quality control, Diffusion, Pollution control.

Identifiers: *Instream aeration.

Results are given on full scale river aeration by two methods (a) release of oxygen into hydroelectric turbines, and (b) diffusion of gaseous oxygen into water under pressure. Oxygen is approximately five times as effective as an equal quantity of air in imparting dissolved oxygen to streams. The authors consider that provided the oxygen is procured at \$30 per ton dissolved oxygen can be added to the water at a total cost of 3 - 4 cents per pound. (Whipple-Rutgers)

W70-03625

CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION).

Ohio Rev Code Ann secs 6101.13, 6101.15, 6101.19 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Administrative agencies, *Water pollution, *Water pollution treatment, Wastes, Liquid wastes, Water supply, Water utilization, Sewage, Sewage disposal, Sewage treatment, Ditches, Sewers, Drains, Rivers, Streams, Flow, Construction, Dams, Dikes, Sluices, Bridges, Water works, Treatment facilities, Supervisory control (Power), Cost analysis, Legislation, Legal aspects, Diversions.

Identifiers: *Conservancy districts, *Purification works, Penalties (Civil).

The board of directors of conservancy districts shall prepare plans for water improvements for their districts. Unless requested by the governing bodies of municipal corporations such plans shall not provide a water supply system or system for sewage disposal. The board of directors has supervisory control over the implementation of plans. In order to accomplish water quality and quantity control, a board may: alter any watercourse, ditch, sewer, river, or stream; fill up the same and divert

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

water flow; construct necessary structures for water control and waste treatment; and construct connections to works for the delivery of water supply or sewage. For these purposes, a board may also acquire, sell, or control real or personal property. A board may make such regulations as are necessary to protect improvements in conservancy districts. It may prescribe regulations for: construction of structures; the connection of sewers, ditches or pipelines with the works of a district; the permissible uses of the water supply; and the discharge of liquid and solid wastes into sewers. Persons violating such regulations shall be liable for their damage. (Duss-Florida)
W70-03644

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03301

RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING,
Gruzinskii Politekhnicheskii Institut, Tiflis (USSR).
For primary bibliographic entry see Field 02A.
W70-03304

A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
For primary bibliographic entry see Field 02A.
W70-03305

ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-03428

GENERALIZING DRY-DAY FREQUENCY DATA,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02B.
W70-03441

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W70-03488

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).
For primary bibliographic entry see Field 02A.
W70-03496

STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03497

RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 04A.
W70-03498

MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,
General American Transportation Corp., Niles, Ill.
For primary bibliographic entry see Field 05G.
W70-03610

AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 05G.
W70-03619

6B. Evaluation Process

THE WATER RESOURCES SITUATION IN PUERTO RICO: AN EVALUATION OF PUBLISHED INFORMATION,
Puerto Rico Univ., Mayaguez. School of Engineering.

A. S. Vazquez, R. B. Ramgolam, H. Q. Vives, and A. R. Villanueva.
Available from the Clearinghouse as PB-189 156, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute Technical Completion Report, Puerto Rico University, Jan 1970. 188 p, 300 ref, 2 index, 1 append. OWRR Proj No A-012-PR.

Descriptors: *Bibliographies, *Abstracts, *Water resources, *Puerto Rico, Surface waters, Groundwater, Water utilization, Water management (Applied), Water resources development, Documentation, Planning, Water quality.
Identifiers: *Water resources bibliography.

A bibliography of water resources of Puerto Rico includes 300 titles and a short abstract of each entry. These works are classified in accordance with the nine categories established by the Committee on Water Resources Research of the Federal Council of Science and Technology. Category and author indexes are given. Some articles have been classified in more than one category. First, under that which describes the nature of its principal theme, and second under those that describe its secondary subject. The author index is arranged in alphabetical order, and the works are identified by their abstract number. (Knapp-USGS)
W70-03245

THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04A.
W70-03246

THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY,
Douglas Schroeder.
Chicago Heritage Committee Newsletter, No. 5, 1964. 33 p, 31 ref.

Descriptors: *Lake Michigan, *Lake shores, *Recreation, *Planning, *Beaches, Lakes, Shores, Recreation facilities, Land forming, Landscaping, Compensation, Beach erosion, Littoral drift, History.
Identifiers: *Chicago, Illinois.

This study discusses the failure of the Chicago Park District to provide adequate planning for the Lakefront Park System. A historical survey of the

development of the Chicago lakefront is used as a vehicle to provide the context for present planning as well as illustrate good planning in the past. A number of objectives for a comprehensive plan of the lakefront are outlined: (1) separation of pedestrian and vehicular traffic; (2) subordination of roadways and parking lots to pedestrian usage; (3) elimination of non-conforming commercial usage; (4) provision for location of desirable commercial concessions, i.e., restaurants, boating, etc.; (5) provision for location of new institutions, i.e., museums, art galleries, athletic fields, etc., and their parking and servicing elements; (6) adequate controls to guarantee that if park land is taken for non-park usages such as superhighways, compensatory land near that taken will be given for park land; (7) integrated design of all park elements including signs, street lighting, beaches, etc.; and (8) a capital improvements program for accomplishing plans and allocating resources. This report illustrates some of the difficulties encountered in lakefront planning. (Davis-Chicago)
W70-03338

FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH,
Office of the Chief of Engineers (Army), Washington, D.C.
George R. Phippen.

Paper presented at the Seventh Biennial Hydraulics Conference, Washington State Univ., Pullman, Wash., 14 Nov 1969. 17 p, 3 fig.

Descriptors: *Flood control, *Flood damage, *Flooding, *Flood plains, Flood protection, Damages.
Identifiers: *Flood plain management.

A flood plain management program should be a comprehensive program, thought of in terms of objectives rather than the means of achieving these objectives. The foundation for understanding flood plain management is the flood hazard; a function of flooding and the susceptibility to damage and disruption. Flooding is described by those physical attributes such as area involved, depths involved, hydrodynamic and hydro-static aspects, time aspects, and pollution and debris aspects. The susceptibility to damage and disruption represents the degree to which cultural features; structures, crop land, continuity of business, etc.; are affected by flooding. Two additional principles of intelligent flood plain management are the nature of and need for stating objectives requiring resolution of the hazard and fitting the flood plain into a larger scheme; and the kinds of optional means available for achieving objectives. It is concluded that flood control myth, is dispelled when flood control is viewed in this larger context of flood plain management. (Davis-Chicago)
W70-03340

LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,
Lincoln City-Lancaster County Planning Commission, Nebr.
For primary bibliographic entry see Field 06F.
W70-03341

THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,
Commissioner of Parks and Public Property, Cedar Rapids, Iowa.
For primary bibliographic entry see Field 06F.
W70-03342

PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES.
For primary bibliographic entry see Field 05G.
W70-03345

Evaluation Process—Group 6B

A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES,
Chicago Univ., Ill. Center for Urban Studies; and Bauer Engineering, Inc., Chicago, Ill.
For primary bibliographic entry see Field 05D.
W70-03346

INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES.

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
Earnest Boyce.
Journal, Water Poll Contr Fed, Vol 41, No 10, p 1697-1701, Oct 1969.

Descriptors: *Water resources development, *Natural resources, *Water development, Water rights, Water law, Planning.

An attempt has been made (a) to point out some of the special problems of water control and development that make this resource inherently different from others and (b) to indicate a few of the legal aspects of these special problems. As a resource, water is a requirement so basic to man's existence that all other resources are either dependent on its plentiful supply or, in its absence, valueless for man's use and development. While many natural resources vanish with use, most water usages produce changes in the position, quality, and/or quantity of the water, depending on how it is used. The multiple usage of the resource, water, within one hydrologic cycle, is frequently an economic necessity. A final distinction is the unpredictable variations in the quantity available from rain and snowfall in any period of time and in any locality. This hydrologic variation is compounded by the variation of human use which is frequently in conflict with the hydrologic variation. This conflict is resolved by some form of water development and management scheme. However, the increase in water use tends to create legal difficulties based on the inadequacies of existing water laws in the case of greater demand than supply. (Davis-Chicago)

W70-03348

SOCIAL BENEFIT VERSUS TECHNOLOGICAL RISK,

California Univ., Los Angeles.
Chauncey Starr.
Sci, Vol 165, No 3899, p 1232-1238, Sept 1969. 7 p, 7 fig, 12 ref, append.

Descriptors: *Risks, Social aspects, *Social values, Project benefits, Public health, Public works, Public benefits, Technology, Accidents, Welfare (Economics), *Hazards, *Safety, Benefit-cost ratios, *Benefits, Acceptability, Comparative benefits, Optimum development plans, Economic justification, Economics, Planning.

Identifiers: Social acceptance, Technical resources, Engineering works.

The evaluation of technologic developments normally relates the expected technical performance to the required investment of resources. Such performance/cost relationships are useful for choosing between alternative solutions, but do not determine how much technology a society can justifiably purchase. A knowledge of the relationship between social benefit and justified social cost is needed to determine the optimum investment of resources. An approach is presented for measuring benefit relative to cost, specifically for accidental deaths arising from technological developments in public use. The analysis is based on 2 assumptions: (1) historical accident records reveal consistent patterns of fatalities in the public use of technology, and (2) historically revealed social preferences and costs are sufficiently enduring to permit use for predictions. Comparisons are made between risks and benefits to evaluate the willingness of society to accept risks. The method provides an approach for answering the question of how safe is safe enough, and may be a means of giving insight on social benefit relative to cost that is so necessary for judicious material decisions on new technological developments. (USBR)

W70-03377

LAND AND WATER CONSERVATION FUND ACT.

Federal Assistance in Outdoor Recreation, Publication No 1, 1968. 99 p.

Descriptors: *Administrative agencies, *Water resources development, *Water conservation, *Water quality control, Federal government, Planning, Recreational facilities, Cost allocation, Land reclamation, Wildlife conservation, Aquatic life, Ecology, Soil conservation, Sedimentation, Erosion, Drainage, Public health, Flood control, Natural resources, Reservoirs, Navigation, Fish management, Meteorology, Grants, Watersheds (Basins).

The Land and Water Conservation Fund Act provides for grants to states and their subdivisions for planning, acquisition, and development of public outdoor recreation areas and facilities. Various federal agencies play a role in the implementation of this program including: the Departments of Interior, Agriculture, Commerce, Defense, Housing and Urban Development, Labor, and Transportation; the Appalachian Regional Commission; the Office of Economic Opportunity; the Tennessee Valley Authority; and the Department of Health, Education, and Welfare. Planning and Research are priorities in the act, both on the state and federal level. Cost sharing and allocation provisions for the various projects are included. Priorities in the implementation of projects include: natural beauty, fish and wildlife conservation, water resources development, water pollution control, soil conservation, land reclamation, public health, water supply, and general ecological considerations. The transfer of land from the federal government to the states for recreational purposes is permitted. Federal agencies are instructed to provide technical assistance to the states in the planning and construction of projects. (Duss-Florida)

W70-03390

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR).

Federal Assistance in Outdoor Recreation, Publication No 1, 1968. 21 p.

Descriptors: *Administrative agencies, *Recreation facilities, *Water resources development, *Water conservation, Planning, State governments, Federal government, Land reclamation, Financing, Public health, Fish management, Wildlife management, Fisheries, Aquatic life, Lakes, Flood control, Water quality control, Water pollution control, Water supply, Waste treatment, Geological surveys, Research, Navigable waters, Ecology, Hydrology.

To qualify for federal grants, states must prepare comprehensive outdoor recreational plans to be approved by the Bureau of Outdoor Recreation. In administering this act, the Bureau is to give special consideration to natural beauty and other qualitative aspects of environment. Among its duties the Bureau is to promote coordination of recreation programs, determine costs and benefits attributable to recreation, and develop policies related to wildlife, waterfowl, natural beauty, and recreational areas. The cost of transfer of federal land to states by purchase or lease is outlined. The Bureau of Sports Fisheries and Wildlife is to assist states and other organizations in realizing the potential of fish and wildlife resources. Funds are allocated and technical assistance is provided for the restoration of fish and wildlife resources. Programs include development of anadromous fish resources, fish hatcheries, and water resource development projects. The Federal Water Pollution Control Administration is to develop plans and programs to assure adequate water supply of the quality necessary for public, industrial, recreational, and conservation needs. The Geological Survey conducts investigations to determine the best use of the nation's water resources. The survey measures the

flow and sediment discharge of rivers, reservoir contents, the chemical quality and temperature of waters, and determines the availability of water supplies. Appropriations are made to states for Water Resources research and training. (Duss-Florida)

W70-03391

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE).

Federal Assistance in Outdoor Recreation, Publication No 1, p 21-34, 1968. 14 p.

Descriptors: *Administrative agencies, *Recreation facilities, *Water conservation, *Water resources development, Watershed management, Cost sharing, Erosion control, Sedimentation, Streams, Lakes, Reservoirs, Irrigation districts, Drainage districts, Construction, Fishing, Wildlife conservation, Water pollution control, Flood control, Legal aspects, Financing, Water management, Rural areas, Public lands, Farm management, Impoundments, Impounded waters.

The Department of Agriculture and its subdivisions have a major interest in programs for outdoor recreation. The Soil Conservation Service provides technical assistance to landowners and helps states in the development of water-based recreational areas. The Agricultural Research Service conducts research on the production of food and conservation of soil and water resources. Projects include: control of disease, insects, and weeds; soil and water management to minimize erosion and sedimentation of streams and reservoirs; and recreational planning. The Agricultural Stabilization and Conservation Service under the Agricultural Conservation Program (ACP) shares costs with farmers to carry out soil, water, woodland, and wildlife conservation projects. Water impoundment projects help to improve hunting and fishing and water resources. Cropland adjustment and conversion programs are encouraged to divert land to recreational use and conservation needs. Financing of projects by associations and individuals is permitted. Loans are available for watershed projects carried out by state conservation, drainage, irrigation, or flood prevention districts. Cost sharing is also available for providing sanitary facilities and facilities needed for recreation. (Duss-Florida)

W70-03392

LAND AND WATER CONSERVATION ACT (DEPARTMENTS OF COMMERCE AND DEFENSE).

Federal Assistance in Outdoor Recreation, Publication No 1, p 35-46, 1968. 11 p.

Descriptors: *Administrative agencies, *Recreational facilities, *Water resources development, *Water conservation, Tourism, Natural resources, Fish conservation, Wildlife conservation, Reservoirs, Tides, Charts, Weather forecasting, Warning systems, Navigation, Estuaries, Channels, Harbors, Flood control, Streamflow, Flood plains, Regulation, Regulated flow, Boating, Shore protection, Projects, Financing.

Identifiers: Corps of Engineers.

The Business and Defense Services Administration will give information to businessmen concerning equipment and facilities used in outdoor recreation. Economic development programs for standard areas, controlled by the Department of Commerce, may be devoted to tourism, recreation, and fish and wildlife. The Environmental Science Services Administration (ESSA) produces charts required in marine navigation. The charting program includes investigation of navigational hazards, prediction of tides and tidal currents, and research and development. The ESSA, through the Weather Bureau, is responsible for keeping the public informed of weather conditions influencing recreational activities. It accomplishes this by means of weather forecasts including river forecasts, flood warnings, and flow information. The United States Army Corps of Engineers is in

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

charge of projects concerning navigation, flood control, hydroelectric power production, shore restoration and protection, water supply, stream-flow regulation, fish and wildlife conservation, and recreation. The Secretary of the Army is authorized to grant leases of project lands to non-federal governmental bodies without charge. Administration of recreational water resources projects shall be on a cost sharing basis. The Corps of Engineers plans and constructs harbors and channels for purposes of navigation and prepares charts of the Great Lakes. The federal government assumes the cost of restoration and protection of federally owned shores. (Duss-Florida)

W70-03393

LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS).

Federal Assistance in Outdoor Recreation, Publication No 1, p 47-99, 1968. 53 p.

Descriptors: *Administrative agencies, *Recreational facilities, *Water pollution control, *Water resources development, Planning, Abatement, Research, Potable water, Environmental sanitation, Solid wastes, Water supply, Water utilization, Projects, Conservation, Health, Cost sharing, Natural resources, Legal aspects, Navigation, Wildlife management, Reservoirs, Fishing, Public rights, Reclamation, Flood control, Bodies of water.

Under the Department of Health, Education, and Welfare, the National Center for Urban and Industrial Health has instituted programs for environmental sanitation, solid waste disposal, water supply, and sea resources. The Department of Housing and Urban Development is authorized to assist in recreation projects. There is an Open-Space Land Program for these purposes. Recreation projects may include improvement of parks and waterfront areas and construction of rain shelters and sanitary facilities. The Department of Transportation is to strive for a system of highways which serves to promote roadside development and highway access, and which focuses attention on outdoor recreation. Priorities in this include conservation of recreation, natural resources, and fish and wildlife. The United States Coast Guard is responsible for enforcement of federal laws on the high seas and in United States waters. It further functions to aid navigation and water safety. The Appalachian Regional Commission initiates project proposals and plans for the region, many of which are to benefit recreation and fish and wildlife resources. The Tennessee Valley Authority is to encourage the development of recreation resources resulting from its construction of a water control system. The Water Resources Council administers a program of grants to states to assist in the development of water and land related resource plans. (Duss-Florida)

W70-03394

WATER RESOURCES.

Tenn Code Ann secs 70-2001 thru 70-2005 (Supp 1969).

Descriptors: *Tennessee, *Water conservation, *Water resources, *Water resources development, Legislation, Administrative agencies, Administration, Water policy, Water pollution, Water supply, Water rights, Dams, Recreation, Environmental sanitation, Navigation, Resource development, Conservation, Optimum development plans, Water requirements, Competing uses, Engineering personnel, Water pollution control.

A Water Resources Division is created within the Department of Conservation. The Commissioner of Conservation shall appoint a professional water engineer to head this Division. The engineer shall be responsible for all matters relating to the conservation, protection, and development of the water

resources of the state, as well as the creation and development of a long range water resource policy. Special matters of water pollution control are reserved for the Stream Pollution Control Board. Specific duties of the engineer include the authority to: (1) establish, maintain and publish an inventory of the state's water resources; (2) establish estimates of existing and future water use in the state; (3) propose necessary water control districts; (4) create and define the rights of respective competing users of water resources; (5) perform assigned duties relating to determining waters that should be reserved for general public purposes; (6) determine the feasibility of proposed dams; and (7) perform other duties required by the Commissioner of Conservation. Any person withdrawing fifty thousand or more gallons of water per day from the water resources of the state must register such withdrawal when required by the Water Resources Division. (Schram-Florida)

W70-03421

TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.

Tenn Code Ann secs 70-2101 thru 70-2104 (Supp 1969).

Descriptors: *Tennessee, *Interstate compacts, *River basin development, *Tennessee River, Interstate rivers, Rivers, Streams, River basins, River basin commissions, Basins, Water resources development, Optimum development plans, Transportation, Interstate commissions, Federal government, Legislation, State governments, Administrative agencies, Navigable waters, Navigable rivers, Channels, Channel improvement, Alabama, Mississippi, Navigation.

The Governor is authorized to execute this compact with Alabama and Mississippi. The purpose of this compact is to promote the development of a navigable waterway connecting the Tennessee River, Tombigbee River, Mackeys Creek, and Yellow Creek so as to provide a nine-foot navigable channel between Demopolis, Alabama and Pickwick Pool, Mississippi, and establish an interstate authority to assist in these efforts. The Tennessee-Tombigbee Waterway Development Authority is hereby created. The Authority is empowered to: hold hearings, conduct studies and surveys of all matters concerning development of the Tennessee-Tombigbee Waterway, acquire money and property for use in the program, cooperate with other public or private groups with an interest in the area, execute plans and policies for putting the purpose of this compact before Congress and other federal agencies, and exercise such other powers as may be appropriate to carry out the purposes of this Compact. All officers of this state are directed to do all things within their jurisdiction to aid in carrying out the purposes of this Compact. (Smith-Florida)

W70-03422

ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT.

California Univ., Berkeley. Sanitary Engineering Research Lab.

For primary bibliographic entry see Field 05G.

W70-03428

WATER RESERVOIR SYSTEMS.

Autonetics Division of North American Rockwell Corporation, Anaheim, California, Life Sciences Operations.

For primary bibliographic entry see Field 04A.

W70-03435

REVIEW AND ANALYSIS OF THE COSTS OF DESALINATED SEA WATER,

Massachusetts Inst. of Tech., Cambridge. Dept. of Economics; and Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.

For primary bibliographic entry see Field 03A.

W70-03453

WATER DEVELOPMENT AUTHORITY.

Ohio Rev Code Ann secs 6121.01 thru 6121.05 (Page Supp 1970).

Descriptors: *Ohio, *Administrative agencies, *Water resources development, *Water pollution control, Beneficial use, Water resources, Water quality, Pollution, Abatement, Public health, Sewage, Industrial wastes, Waste water, Water management, Waste treatment, Costs, Construction, Projects, Surface waters, Groundwater, Water utilization, Solid wastes, Aquatic life, Wildlife, Bodies of water, Flow.

Identifiers: *Water development authority.

Various terms related to water resources and water conservation in Ohio are defined including: beneficial use, waters of the state, water resources, water development project, pollution, industrial waste, waste water, waste and water management facilities. It is the state policy of Ohio to conserve, develop, utilize and maintain its water resources; to prevent or abate water pollution; and to promote the beneficial use of state waters. Pursuant to this policy, the Ohio Water Development Authority is created. The Authority may make loans or grants to governmental agencies for the acquisition or construction of water development projects. It may establish rules and regulations for use of water development projects. It may also establish rules and regulations to protect augmented flow in state waters brought about by development projects, and may provide standards for withdrawal of augmented flow. Methods of financing, operation, and supervision of water development projects are described. The Authority may engage in research and development with respect to waste water and water management facilities. (Duss-Florida)

W70-03575

GREAT LAKES BASIN COMPACT.

Ohio Rev Code Ann secs 6161.01 thru 6161.03 (Page Supp 1970).

Descriptors: *Ohio, *Interstate compacts, *Water resources development, *Water conservation, Great Lakes, Basins, Navigation, Water supply, Recreation, Water utilization, Legislation, Fisheries, Wildlife conservation, Fish conservation, Regulation, Flood plain zoning, Harbors, Water levels, Research, Water pollution control, Soil erosion, Bank erosion, Floods, Interstate commissions, Diversion, United States, Administrative agencies. Identifiers: *Great Lakes Commission.

The Great Lakes Basin Compact is herein ratified and enacted. The purposes are to: promote the development, use, and conservation of water sources of the Great Lakes Basin; to derive maximum benefit from public works related to navigation and other activities; and to advise in securing a proper balance among the various legitimate uses of water resources. The Compact will be effective when enacted by the legislatures of any four of the states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. Pursuant to this Compact a Great Lakes Commission is created, and its composition and method of operation are described. The Commission has the power to: collect and interpret data on water resources; make recommendations on water resources development and conservation; consider the need for public works related to water resources; consider means of improving navigation and improving and maintaining fisheries; and recommend policies related to water resources. Each state shall consider the Commission's recommendations concerning: stabilization of lake levels; measures for combating pollution, floods and beach erosion, navigation aids and improvements; cooperative fishing laws and fish management; cooperative programs for soil and bank erosion; and diversion of waters. (Duss-Florida)

W70-03577

Cost Allocation, Cost Sharing, Pricing/Repayment—Group 6C**SOIL AND WATER CONSERVATION COMMISSION.**

Ohio Rev Code Ann secs 1515.01 thru 1515.14 (Page 1964), as amended, (Supp 1970), secs 1515.15 thru 1515.29 (Supp 1970).

Descriptors: *Ohio, *Flood control, *Water resources development, *Water conservation, Administration, Soil conservation, Administrative agencies, Legislation, Legal aspects, Natural resources, Regulation, Financing, Planning, Surveys, Investigations, Flood damage, Soil erosion, Taxes, Water utilization, Construction, Cost sharing, Water pollution control, Pollution abatement, Operation and maintenance.

The Soil and Water Conservation Commission is established with the following duties and powers: (1) to assist and encourage cooperation between the soil and water conservation district supervisors; (2) to disseminate information to district supervisors; (3) to seek the cooperation and assistance of federal agencies on behalf of the districts; (4) to recommend legislation which will encourage proper management of natural resources; and (5) to recommend to the Director of the Department of Natural Resources priorities for planning and construction of small watershed projects. Landowners within a given territory may petition the Commission to establish a district within that territory. If the Commission determines there is a need for the district it may order a referendum to be held. Once a district is created, supervisors will be elected in the manner set forth. District supervisors have the following powers: (1) to conduct surveys, investigations, and research relating to soil and water conservation and flood control; (2) to draft and implement plans for conservation of soil and water resource and for flood control; and (3) to cooperate with land occupiers in carrying out the foregoing powers. Financing of district projects is provided for through taxation, special assessments, and bond issues. (Keith-Florida)

W70-03578

ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS.

Booz-Allen and Hamilton, Inc., Washington, D.C.

Available from the Clearinghouse as PB-189 339, \$3.00 in paper copy, \$0.65 in microfiche. Technical Completion Report, Jan 1970. 99 p, 15 tab, 1 fig, 91 ref, 3 append. OWRR Project C-1370 (1974).

Descriptors: *Administrative agencies, *River basins, *Management, Planning, Federal Government, State government, Local government, Comacts, Water rights. Identifiers: *Organizational arrangements, Interagency committee, River basin commission, Private corporation, Special districts, Federal regional agency.

An analysis was made of different types of regional water resources institutional arrangements in an attempt to describe the distinguishing characteristics of each and to ascertain their inherent strengths and weaknesses. Seven river basins were selected to provide examples of the implementation of six different regional arrangements. An analysis of each of the seven basins is presented with primary emphasis placed upon the organizational arrangements that have evolved for planning and operating. The selected basins were: (1) the Colorado River Basin, (2) the Columbia River Basin, (3) the Miami River Basin, (4) the Wisconsin River Basin, (5) the Delaware River Basin, (6) the Tennessee River Basin, and (7) the Colorado River Basin (Texas). Major conclusions include: (1) the river basin commission, the intrastate special district, and the federal interstate compact hold the most promise for river basin development, (2) the federal regional agency is an effective arrangement

but implementation difficulties prohibit its widespread use, and (3) the major weakness of the basin interagency committee arrangement is its lack of authority to implement the plans created. W70-03611

THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT,

North Carolina Water Resources Research Inst., Raleigh.

Raymond J. Burby, III.

Available from the Clearinghouse as PB-189 408, \$3.00 in paper copy, \$0.65 in microfiche. Interim Report, North Carolina Water Resources Research Institute, Report No 29, Nov 1969. 56 p. OWRR Project B-012-NC.

Descriptors: *Reservoirs, *Recreation, *Land development, *Lake shores, *Local government, *Planning, *Land use, *Land management, Forest management, Southeast U. S., Inter-agency cooperation, Recreation facilities, Zoning, Urbanization, *Water resources development, Developed waters, Aesthetics. Identifiers: *Reservoir owners, Land acquisition, Residential use, Commercial use, Industrial use.

Land adjoining reservoirs with recreation potential has been developed at an increasing rate since 1960. A survey of 105 large multipurpose reservoirs in the Southeast indicated that these reservoirs have attracted over 60,000 homes and summer cottages. This rapid development is occurring in a governmental vacuum. Under ten percent of the reservoirs surveyed have land use plans, zoning, or subdivision regulations to guide the development of adjacent non-public land. In the absence of local government adjacent reservoir owners may have a key role in maintaining the quality and public usefulness of reservoir shorelands. This report investigates reservoir owner policies which may be used to influence the location and character of shoreline development. Policies considered include land acquisition, residential, commercial, industrial, recreation, and forest land utilization, land management, and inter-agency cooperation. The experience of 25 Southeastern reservoir owners, including Corps of Engineers' districts, private power companies, and TVA, interviewed for this report indicates a wide variation in the current application of each of the above policies, but suggests that reservoir owners, in cooperation with local governmental units, can develop policy mixes adequate to protect reservoir shoreline environments. W70-03616

AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT,

Clemson Univ., S.C. Dept. of Environmental Systems Engineering.

For primary bibliographic entry see Field 05G.

W70-03619

6C. Cost Allocation, Cost Sharing, Pricing/Repayment**THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES,**

Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.

Henry C. Bramer, and Donald J. Motz.

Available from the Clearinghouse as PB-189 248, \$3.00 in paper copy, \$0.65 in microfiche. A continuation of OWRR Contract 14-01-001-1581. (See Vol 2, No 9, Field 6C, entry W69-03322). Completion Report, Dec 1969. 192 p, 16 tab, 2 fig, 3 append. OWRR Project C-1511 (1990).

Descriptors: *Industrial water usage, *Industrial water costs, *Economic efficiency, Statistical model, Data acquisition form, Water resources utilization.

Identifiers: *Water utilization, Data acquisition, Mathematical model.

A study was made to acquire and evaluate data on the cost of industrial water utilization in the steel, paper, chemical, and petroleum industries in sufficient quantity to provide statistically reliable data on each industry as a whole. Data was collected with the industrial water use data form developed for this study. A statistical model was developed to supply a means by which industrial water utilization costs could be formulated by machine computation from the input data forms, used to construct models of industrial water utilization systems, and used to generate formatted data on industrial water utilization costs. The study was used to illustrate how data on industrial water costs can be used to promote more efficient water resource utilization by industry, government, and other water resource planners. W70-03431

COST HANDBOOK FOR INDUSTRIAL WATER USES,

Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.

Henry C. Bramer, and Donald J. Motz.

Available from the Clearinghouse as PB-189 253, \$3.00 in paper copy, \$0.65 in microfiche. Completion Report, Dec 1969. 62 p, 16 tab, 2 fig, 1 append. OWRR Project X-105 (1997).

Descriptors: *Water use cost, *Cost per unit product, Steel, Paper, Chemical, Petroleum, Mathematical model, Data retrieval.

Identifiers: *Process water, *Water utilization cost, Heavy industry, Water quality, Waste treatment, Statistical analyses of data.

This handbook illustrates the application of the methods developed in the study entitled 'The Value of Water in Industrial Uses - A Continuation.' It presents general conclusions as to the nature of industrial water utilization and costs, illustrates the utility of the Industrial Water Use Data Form in formating and retrieving data, illustrates the ability of the form in compiling data, and the use of the data generated in specific problem areas. General conclusions were: (1) The cost of industrial water utilization are best determined on the basis of cost per unit product, (2) Water utilization costs were not found to be definable functions of the age of the plant or level of technology, and (3) In general, industrial water utilization costs have not been shown to be predictably or functionally related to many water use parameters. More specific conclusions and examples are given for the industries. (Hutchins-NUS Corporation)

W70-03432

PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL,

North Carolina Water Resources Research Inst., Raleigh; North Carolina State Univ., Raleigh; and North Carolina Univ., Chapel Hill.

For primary bibliographic entry see Field 05G.

W70-03439

DRAINAGE DISTRICTS (TAXATION).

For primary bibliographic entry see Field 04A.

W70-03569

LEVEES.

For primary bibliographic entry see Field 04A.

W70-03581

MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,

General American Transportation Corp., Niles, Ill.

For primary bibliographic entry see Field 05G.

W70-03610

Field 06—WATER RESOURCES PLANNING

Group 6D—Water Demand

6D. Water Demand

DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES,

Puerto Rico Univ., Mayaguez. School of Engineering.

Luis A. Nunez.

Available from the Clearinghouse as PB-789 158, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Research Institute Technical Completion Report, Puerto Rico University, Dec 1969. 72 p, 2 fig, 1 tab, 7 ref, 5 append. OWRR Proj No A-008-PR.

Descriptors: *Water utilization, *Domestic water, *Water pressure, *Puerto Rico, Water supply, Water distribution (Applied), Water management (Applied), Water policy, Water works, Water demand, Planning.

Identifiers: Water pressure-consumption relations, Domestic water consumption.

An experimental study of water consumption in Mayaguez, Puerto Rico determined that pressure is not related to domestic consumption. The cause of variations in the city's domestic consumption was not determined. Data used in the study are tabulated. A brief literature review summarizes the findings of recent studies and consumption surveys. (Knapp-USGS)

W70-03247

PAYMENTS TO STATE FOR WATERS DIVERTED.

NJ Stat Ann secs 58:2-1, 58:2-2, 58:2-4 (1966).

Descriptors: *New Jersey, *Diversion, *Water rates, *State governments, Legislation, Legal aspects, Diversion loss, Returns, Cities, Water supply, Streams, Rates, Administrative agencies.

Every municipality, corporation, or private person diverting the waters of streams or lakes with outlets for the purpose of a public water works shall make payments to the state for all such water diverted in excess of a total amount equal to 100 gallons daily for each inhabitant of the municipalities supplied, as shown by the census of 1905, or in excess of such amount as was legally diverted in 1907. The state Water Policy Commission shall provide maximum and minimum rates for water so diverted. Any water used for manufacturing and fire purposes only and returned without pollution to the stream from which it was taken shall not be included in the aggregate amount diverted. There is a state fee charged for water diverted from subsurface, well, or percolating water supplies acquired by condemnation by exercising the state's right of eminent domain. (Sisserson-Florida)

W70-03517

6E. Water Law and Institutions

FISHING - UNLAWFUL METHODS.

Ind Ann Stat secs 11-1605 thru 11-1614 (1956), as amended, (Supp 1968).

Descriptors: *Indiana, *Fish, *Fishing, *Fishing gear, Legislation, Regulation, Administration, Sport fishing, Explosives, Electrical shocking gear, Fish toxins, Poisons, Nets, Seines, Trout, Minnows, Bass, Crayfish, Fish conservation, Fish management.

Identifiers: Penalties (Criminal).

It is unlawful to use seines, nets, traps, gaff hooks, snares, gigs, spears, electrical devices, explosives, fish toxins, or poisons for fishing. Penalties for violation of these provisions are set forth. Nets are permitted in Lake Michigan and the Wabash River boundary waters. Trot lines and similar devices are unlawful except at certain times and in certain geographical locations. The taking and transporting of

minnows is regulated as are the permissible methods for the taking of trout, gar, dog fish, and carp. The sale of bass of specified varieties is prohibited unless such sale is for breeding or stocking purposes. The owners of the breeding and stocking ponds must obtain a permit from the Director of the Indiana Department of Conservation. (Moulder-Florida)

W70-03299

INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES.

Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

For primary bibliographic entry see Field 06B.
W70-03348

THE FEDERAL VIEW OF DAMAGES AND BENEFITS,

Department of Justice, Washington, D.C.

Clyde O. Martz.

Appraisal J, Vol 37, No 2, p 200-210, Apr 1969. 11 p, 29 ref.

Descriptors: *Damages, *Benefits, *Land appraisal, *Condemnation, *Property values, Right-of-way, Land tenure, Pricing, Value, Severance, Bibliographies, Land, Eminent domain, Condemnation value, Land ownership, Legal aspects.

Identifiers: *Land acquisition, Severance damages, Department of Justice.

When a Federal agency has difficulties in acquiring land for project use, the Department of Justice is requested to institute condemnation proceedings and conduct all negotiations and trial activities. Few cases ever come to trial; 75-80% are settled by judgment entered as a result of stipulations or failure of the landowner to appear. Federal law, not local state law, applies in Federal condemnation cases. One of the most misunderstood and unjustly criticized aspects of eminent domain is the allowance of benefits or value increase of remaining land to offset any compensation award for the land taken or for severance damage. Any enhancement in the value of property taken for a project cannot be considered in determining just compensation. Since benefits must be considered, the remainder is valued to the extent that the value is enhanced by the project. If the land taken is not considered enhanced by the project but the value of the aggregate is considered to be lessened by the taking, the landowner can be made whole by adding his compensation to the sum he might gain from the sale of the remainder in the market. Definitions and discussions are given regarding general, special, direct, and indirect benefits. (USBR)

W70-03361

ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION--INFORMATION CENTER.

For primary bibliographic entry see Field 05G.

W70-03379

PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS,

G. Graham Waite.

Wis L Rev, Vol 1958, No 3, p 335-375, May 1958. 41 p, 162 ref.

Descriptors: *Wisconsin, *Riparian rights, *Navigable waters, *Access routes, Legislation, State governments, Competing uses, Remedies, Ownership of beds, Obstruction to flow, Construction, Reasonable use, Recreation, Riparian land, Legal aspects, Boundaries (Property), Boundary disputes, Easements, Judicial decisions, Boating, Sport fishing, Swimming, Aesthetics, Economic impact, Hunting, Lakes.

Wisconsin is involved in determining through legislation, judicial decisions, and administrative regulation whether public or riparian owners shall have access to navigable waters. In analyzing the

Wisconsin position, it is concluded that the public's right of access to navigable waters is restricted to those parts of the shoreline that can be reached without crossing private property. In reaching this result, possible alternatives and the policy reasoning behind the conclusion are examined. Priorities between recreational and commercial uses and between riparian and public rights are explored in gaining insight into the state's position. The theories of lake bed and stream bed ownership are considered as justifications of this position, as is the effect of the public right to navigation on navigable streams. The article concludes that for the public to best achieve access to navigable waters it must rely on legislation by local governments to open public roads to such waters. (Barnett-Florida)

W70-03380

MARITIME CONTIGUOUS ZONES,

Lloyd C. Fell.

Mich L Rev, Vol 62, No 5, p 848-864, Mar 1964. 17 p, 84 ref.

Descriptors: *Law of the sea, *International law, *Seas, *Oceans, Admiralty, Navigation, Legislation, Regulation, Littoral, United Nations, Fishing, Coasts, Jurisdiction.

Identifiers: Contiguous zones, Territorial waters.

This is a discussion of the problems involved when a coastal state asserts authority for special purposes over a zone of the sea outside its territorial waters. Early contiguous zones were acquiesced in when they appeared reasonable. The term contiguous zone is generally applied to those areas in which the littoral state exercises limited competence for special purposes, as distinguished from territorial waters over which it has sovereignty. There is no necessary relation between the width of the territorial sea and the establishment of the contiguous zone. A majority of states asserting contiguous zones have laws directed solely at enforcing the rights claimed therein. The problems of territorial seas and contiguous zones are being considered by the United Nations. The Geneva Conferences validated customs, fiscal, immigration, and sanitary zones up to twelve miles from shore which in effect limited the subjects amenable to contiguous zone treatment. (Moulder-Florida)

W70-03381

ARE WE LOSING OUR LAKES,

Roger A. Peterson.

S D L Rev, Vol 3, p 109-125, Spring 1958. 35 p, 89 ref.

Descriptors: *Reservation doctrine, *Ownership of beds, *Riparian rights, *Public rights, State governments, Accretion (Legal aspects), Lake beds, Lakes, Navigable waters, Riparian land, Federal government, Patents, Leases, Non-navigable waters, Minnesota, Illinois, Iowa, South Dakota, North Dakota, State jurisdiction, Federal jurisdiction, Legislation, Judicial decisions.

The article explores a limited cross-section of the divergent judicial decisions dealing with lake bed ownership disputes between the state and littoral owners and the retention of bed ownership by the state for public use. Two theories by which the state may acquire title to submerged beds are explored. The first theory gives the state title to all lakes and rivers which were navigable, according to the federal test of navigability, at the time the state was admitted to the Union. The second theory provides that a state may acquire title to lake beds if the federal government sold the property on which lakes were situated without indicating an intent to reserve or dispose of such property, regardless of the navigability of the lakes. After exploring the background of the federal navigability test, the judicial decisions of Minnesota, Iowa, Illinois, North Dakota, and South Dakota are examined with regard to their method of applying the two theories. It is concluded that Iowa, Illinois, and South Dakota adhere to the second theory, retaining greater ownership for public use. Unrestricted federal

patents vis-a-vis state jurisdiction are discussed. (Barnett-Florida)
W70-03382

ARE WE LOSING OUR LAKES (STATE'S ACQUISITION OF TITLE UPON ADMISSION TO THE UNION),

Roger A. Peterson.
S D L Rev Vol 3, p 109-113, Spring 1958. 5 p, 22 ref.

Descriptors: *Ownership of beds, *Lake beds, *Reservation doctrine, State governments, Public rights, Navigable waters, Federal government, Non-navigable waters, State jurisdiction, Federal jurisdiction, Boundaries (Property), Patents, Judicial decisions, Beds under water, Beds.

Following the American Revolution, each state held title to the beds of all navigable waters. Navigability was determined by the English test of whether the water was affected by the ebb and flow of the tide. Non-navigable beds were owned by the littoral or riparian owners. Each state subsequently admitted to the Union acquired title to navigable waters within its borders. Prior to admission, such waters were held by the federal government in trust for the new states. The English test of navigability was later discarded. For a state to claim title to waterways the test of navigability applied was whether the waters were, in fact, highways of commerce. The federal test differed from later developed state tests; the differences were resolved, however, in *United States v Holt State Bank*, 270 U S 49 (1926). Simply stated, the law is that each state, upon admission to the Union, acquired title to rivers and lakes if they were at that time navigable under the federal test. Other waters not navigable remain the property of the federal government. (Barnett-Florida)
W70-03383

ARE WE LOSING OUR LAKES. (STATE'S ACQUISITION OF TITLE THROUGH CONSTRUCTION OF FEDERAL PATENTS ACCORDING TO LOCAL LAW),

Roger A. Peterson.
S D L Rev Vol 3, p 113-118, Spring 1958. 6 p, 20 ref.

Descriptors: *Ownership of beds, *Reservation doctrine, *Riparian rights, Accretion (Legal aspects), Federal government, Patents, Non-navigable waters, Federal jurisdiction, Legislation, State jurisdiction, Public rights, Judicial decisions, Beds, Beds under water, Legal aspects.

Judicial decisions are used to show the precedent for applying local law rather than federal law in construing an unrestricted federal patent on non-navigable waters. It is made clear that if, under local law, title to a lake bed is not transferred under a private grant of the upland property, it is not transferred under an unrestricted federal patent. The question of who takes title to a lake bed that is surrounded by littoral owners who are claiming under unrestricted federal patents raises serious questions. An exploration of case law shows an expansion of sources from which restriction may be placed on any patent to avoid such conflicts. It has been concluded, however, that the definition of an unrestricted federal patent is purely a question of fact, dependent upon the intent of the federal government. Federal legislation requiring federal assent to the application of local law in construing its grants is a suggested reform. (Barnett-Florida)
W70-03384

ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH THEORIES TO RETAIN CONTROL OF THE LAKES),

Roger A. Peterson.
S D L Rev, Vol 3, p 118-125, Spring 1958. 7 p, 30 ref.

Descriptors: *South Dakota, *Iowa, *Illinois, *North Dakota, Minnesota, Ownership of beds, Judicial decisions, Accretion (Legal aspects), State governments, Riparian rights, Lake beds, Lakes, Navigable waters, Riparian land, Federal government, Non-navigable waters, State jurisdiction, Public rights.

Two theories of lake bed ownership by the states have been applied. The first theory gives each state title to all navigable waters which were navigable under the federal test at the time of its admission to the Union. Under the second theory, the state may acquire title to lake beds, if the federal government transferred lake-front property without reservations, whether the lake is navigable or not. Minnesota applied a local test until 1957, when their state supreme court stated the rule that Minnesota could assert ownership over waters, as an incident of statehood, due to their navigability as determined by the federal navigability test. North Dakota followed the Minnesota test. In South Dakota, the Minnesota test was adopted, but pursuant to statute the state was deemed to own all waters which were navigable under the federal test. Iowa has avoided using the two theories explicitly, but implicit in its court decisions is the policy that the littoral owner does not acquire title to lake beds and that the state has sufficient interest to protect non-navigable lakes. Illinois has adopted the first theory by merely making a meander line conclusive evidence of navigability and thus vesting all ownership of navigable lake beds in the state. (Barnett-Florida)
W70-03385

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA,

Roger H. Doyle.
1963 Tulane Tidelands Inst, p 28-46, Claitor's Book Store, Baton Rouge, La. 18 p, 65 ref.

Descriptors: *Louisiana, *Beds, *Rivers, *Ownership of beds, Beds under water, Dry beds, Lake beds, River beds, Streambeds, Channel erosion, Navigable rivers, Banks, Bank erosion, Stream erosion, Mineral industry, State governments, Legislation, Shores, Estuaries.

Identifiers: Alienability of waterbottoms.

Inalienability is a characteristic of sovereign ownership of navigable waterbottoms. So long as the common or public uses are preserved, the beds and bottoms of navigable waters are susceptible of private ownership. The actual beds of navigable waters under Roman, Spanish, and common law were alienable when separable from the public use. Louisiana's constitutional prohibition against alienation of the beds of navigable waterways acknowledges their pre-existing susceptibility of private ownership. Adoption of the common law rule would have been more appropriate in a capitalistic society. Act 62 of 1912 cures defects in unauthorized transfers of waterbottoms. Subsequent cases conflict as to whether the beds of navigable waterways are susceptible to private ownership. California Co v Price, 225 La 706, 74 So 2d 1 (1954) cured the title to 4,000 acres of navigable waterbottom. The court in *Miami Corp v State*, 186 La 784, 173 So (1936) gave the state title to inundated lands on the basis of the insusceptibility of navigable waterbottoms to private ownership. *State v Cenac*, 341 La 1055, 132 So 2d 928 (1961) held that Price established the validity of private ownership and cast doubt on the validity of the Miami decision. (Dye-Florida)
W70-03386

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY I),

Roger H. Doyle.
1963 Tulane Tidelands Inst, p 28-34, Claitor's Book Store, Baton Rouge, La. 7 p, 25 ref.

Descriptors: *Louisiana, *Beds, *Ownership of beds, *Legislation, Rivers, Beds under water, Dry beds, Lake beds, River beds, Streambeds, Navigable rivers, State governments, Riparian rights, Civil law, Legal aspects, Recreation, Relative rights, Public rights, Boundaries.

Identifiers: Alienability of waterbottoms.

Sovereign ownership of waterbottoms is divided into perfect proprietary ownership, dominium, and imperium. Roman, Spanish and the common law allowed alienation of the dominium, but not the imperium. If the two forms of ownership were inseparable, neither was alienable nor subject to private ownership. Imperium was exerted over the right of public use, as navigation or fishing, while dominium applied to separable physical bed. French law differed from the common law by making inalienable the thing to which the public use related in addition to the use itself. Louisiana Code articles classifying common things derives from Roman law. The article defining things public derives from French law. Thus, historical derivation is of no help in determining a Louisiana rule regarding private ownership of waterbottoms. Early Louisiana cases pronounced waterbottoms insusceptible of ownership subsequent to the first of the 'oyster acts' in 1886. These acts and the prohibition in the 1921 Louisiana Constitution against alienation to private ownership are implicit recognition of a prior susceptibility to such ownership. Adoption of the common law rule would have been more appropriate for a capitalist society. (Dye-Florida)
W70-03387

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY II),

Roger H. Doyle.
1963 Tidelands Inst, p 34-38, Claitor's Book Store, Baton Rouge, La. 5 p, 19 ref.

Descriptors: *Louisiana, *Beds, *Ownership of beds, *Legislation, Rivers, Beds under water, Dry beds, Lake beds, River beds, Streambeds, Navigable rivers, State governments, Riparian rights, Legal aspects, Relative rights, Public rights.

In 1908, the Louisiana Supreme Court held that the 1886 'oyster statute' constituted legislative ratification of pre-existing private title to an arm of the sea. The unauthorized alienation of the bottom was found to have been cured by laches on the part of the state. This estoppel by laches was codified by Act 62 of 1912, curing unauthorized or void transfers from the state or its agencies. Courts have not required transfers to be express to benefit from Act 62. Titles to waterbottoms included in a transferred area are also cured. *Humble Oil v State Mineral Bd*, 223 La 47, 64 So 2d 839 (1953) applied the Act to effect the transfer of the bottom of a navigable waterway by a state agency totally without title. *California Co v Price* applied the Act to an arm of the sea. *Miami Corp. v State*, however, gave the state title to inundated land because waterbottoms are insusceptible of private ownership under the codal articles. (Dye-Florida)
W70-03388

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES),

Roger H. Doyle.
1963 Tulane Tidelands Inst, p 38-46, Claitor's Book Store, Baton Rouge, La. 9 p, 20 ref.

Descriptors: *Louisiana, *Beds, *Ownership of beds, *Lake beds, Lakes, Rivers, Beds under water, Dry beds, River beds, Streambeds, Channel erosion, Banks, Bank erosion, Stream erosion, State governments, Legislation, Shores, Legal aspects, Boundaries (Property), Accretion (Legal aspects), Alluvion, Reliction, Riparian rights.

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Miami Corp v State involved title to the bed of a changing body of water. Early cases held that neither accretion of the shores of a lake, nor lands left dry by receding waters accrue to the riparian owner. Conversely, in Miami, the court held that the state acquired title to areas inundated subsequent to the issuance of a patent because the bed was not susceptible to private ownership. On this point, the later California Co v Price case held otherwise. Statutes limit application of the Miami doctrine to true quiescent lakes. Factual distinctions between Miami and Price raise doubts that Miami was overruled. Price did not involve erosion or inundation and applied only to post-patent inundation. State v Cenac involved inundation of patented and unpatented beds, and thus involved the facts of both Price and Miami, and thereby offered an opportunity to reconcile the two doctrines. The state waived this opportunity by insisting that Price be overruled and that post-patent as well as pre-patent inundations cause reversion of beds to the state. The court upheld the Price doctrine and applied it to the entire inundated property, casting the Miami doctrine into even greater doubt. (Dye-Florida)
W70-03389

CONSERVATION OF NATURAL RESOURCES (FISHING).

Ohio Rev Code Ann secs 1533.32 thru 1533.66 (Page 1964), as amended, (Supp 1970).

Descriptors: *Fishing, *Nets, *Ohio, *Recreation, Water utilization, Commercial fishing, Bait fishing, Sport fishing, Electrical shocking gear, Fish hatcheries, Fish management, Baits, Fyke nets, Gill nets, Fishing gear, Marking techniques, Legislation, Local governments, Electro-fishing, Permits, Fish passages, Fish, Public health.

Identifiers: Trap nets, Crib nets.

The Attorney General, the Chief of the Division of Wildlife, and the Director of Natural Resources may enter reciprocal agreements with the proper authorities of other states to regulate the catching of fish. Except for certain circumstances listed, the use of a boat, net, or device for fishing requires a license. Fish shall be taken only by angling, unless otherwise provided by the Revised Code. Requirements for the issuance of permits for private fish hatchery ponds and minnow sales are prescribed. The fishing season for Lake Erie and other waters is established. Commercial fishermen are required to record their daily catch. Fishing devices used in the Lake Erie fishing district are regulated. Specific provisions cover the depth, width, length, and mesh size of several types of nets which may be used in fishing. Unauthorized netting locations, Lake Erie netting season dates, and net inspection methods are described. The use of quicklime, electricity, or any other deleterious substances in Ohio waters is proscribed. Any obstruction to the natural transit of fish is prohibited. Requirements as to length, weight, and methods of taking specific species of fish are designated. Fish lawfully confined by a net or device are property of the owner or person operating such net or device. Each fish illegally taken constitutes a separate offense. (Powell-Florida)
W70-03407

WATERCRAFT; NAVIGATION.

Ohio Rev Code Ann secs 1547.01 thru 1547.78 (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Waste disposal, *Boating regulations, *Navigation, Boats, Ships, Water skiing, Harbors, Water policy, Water resources development, Recreation, Water law, Water conservation, Legislation, Environmental sanitation, Recreation wastes, Domestic wastes, Construction, Maintenance, Projects, Bank erosion, Shores, Administrative agencies.

Identifiers: *Refuge harbors.

Waters of the state and navigable waters are defined. Specifications for watercraft lights and operating regulations for preventing collisions between watercraft are enumerated. Various other regulations pertaining to the operation of watercraft are provided. Water skiing activities and watercraft safety measures are prescribed. Except on designated waters, no person shall operate or use any watercraft containing a sink, toilet, or sanitary system capable of discharging wastes. The Division of Watercraft is created to administer the identification and numbering of watercraft operated on Ohio waters. The Division of Watercraft acts as the refuge and small boat harbor agency for the purpose of working with the Corps of Engineers. The Watercraft Division may construct and maintain refuge harbors and other projects related to light draft vessels and marine recreational facilities. A Waterways Safety Council advises the Watercraft Division Chief as to construction and maintenance of refuge harbor projects and methods of coordinating shore erosion projects with refuge harbor projects. Penalties for violations of various sections of the watercraft laws are enumerated. (Powell-Florida)
W70-03408

BRIDGE COMPANIES.

Ohio Rev Code Ann secs 1741.01-1741.14 (Page 1964).

Descriptors: *Ohio, *Bridge construction, *Bridges, *Ohio River, Railroads, Abutments, Regulation, Permits, State governments, Legislation, Rates, Interstate rivers, Construction, Legal aspects, Financing, Standards, Interstate.

Identifiers: *Tolls, *Bridge companies, Toll rates.

A bridge company must lawfully possess a right in the banks of those streams it intends to build its bridges over. Toll rates for intrastate bridges are stipulated. A bridge built across the Ohio River must conform to congressional standards. The maximum and minimum height of bridges built across the Ohio River is stipulated. Reasonable toll rates may be set by the bridge company, but may never exceed those collected at the Covington-Cincinnati Bridge. Upon payment of a stipulated rate of toll, railroad companies may use such bridges built across the Ohio River. Two bridge companies, from different states, may form one consolidated domestic corporation, subject to the regulations of this state, to build a bridge across the Ohio River. The bridge companies may operate ferries as well as make and enforce all rules necessary to protect their property. (Barnett-Florida)
W70-03409

STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT.

Ohio Rev Code Ann secs 123.03, 123.031 (Page 1969), as amended, (Supp 1970).

Descriptors: *Ohio, *Lake Erie, *Riparian land, *Leases, Water rights, Navigation, Land tenure, Shores, Soil management, Littoral, Riparian rights, Channels, Reasonable use, Piers, Landfills, Legislation, Public rights, Administrative agencies, Administrative decisions, Aquatic soils, Local governments, Port authorities, Planning, Programs, Mineralogy, Fisheries.

The water and underlying bed of Lake Erie within the jurisdiction of the state are owned and held by the state for public use, subject to the powers of the United States, rights of public navigation, commerce, and fishery and property rights of littoral owners. The Department of Public Works is responsible for care, protection, and enforcement of the state's interests in this territory. Any owner of uplands fronting on Lake Erie may apply to the state for a lease of the waters and underlying beds or artificially filled lands between the natural shore line and the harbor line, for specified purposes. The

Director of Public Works shall determine whether the suggested improvements and developments will impair public rights. The appropriate municipal corporation, county commission, or port authority shall determine whether the territory is needed by that local authority, and whether the proposed use complies with the authority's waterfront plans. The Director shall establish the consideration for and period of such lease. The Governor shall issue the lease certificate, specifically reserving to the state all mineral rights in the leased territory. (Dearing-Florida)
W70-03410

COMPACT CONCERNING PYMATUNING LAKE.

Ohio Rev Code Ann sec 1541.31 (Page 1964).

Descriptors: *Ohio, *Interstate compacts, *Recreation, *Multiple-purpose reservoirs, Multiple-purpose projects, Legislation, Legal aspects, Boats, Safety, Water conservation, Flood control, Pennsylvania, Dams, Swamps, Water pollution, Reservoirs, Jurisdiction, Fishing, Boating.

Identifiers: *Pymatuning Lake.

Ohio hereby enters into a compact with Pennsylvania concerning Pymatuning Lake. Ohio's Conservation Commissioner is authorized to carry out Ohio's duties under the compact. Pennsylvania's agent for purposes of the compact will be its Water and Power Resources Board. The primary purposes of the project, by which the Lake is created, are water conservation, flood control, and regulation of flow in the Shenango and Beaver rivers. The secondary purposes are to permit fishing, hunting, and recreation in such ways as will not interfere with the primary purposes. The Lake will be open to citizens of both states for fishing, hunting, boating, and recreational purposes. Both states will protect the Lake against pollution from all sources. The only restriction on boating is that no motor will be used in excess of ten horsepower. Pennsylvania reserves the unrestricted right to regulate the level of the Lake in furtherance of a primary purpose of the project: regulation of flow in the Schenango and Beaver rivers. (Keith-Florida)
W70-03411

BOOM COMPANIES.

Tenn Code Ann secs 68-201 thru 68-204 (1956).

Descriptors: *Tennessee, *Lumbering, *Streams, *Navigation, Rivers, Inland waterways, River basins, Lumber, Boats, Regulation, Economics, Legislation, Damages, Riparian rights, Legal aspects, Aquatic drift.

Identifiers: Booms, Boom companies, Obstruction to navigation.

Boom companies may float wood, lumber, and logs down any stream or its tributaries, and may construct booms for the purpose of catching and securing their logs, wood, and lumber. Such booms shall not prevent the safe and convenient passage of rafts, logs, and boats on any river. A boom corporation may enter upon the lands of others for the purpose of reclaiming and securing its logs, lumber and rafts. The corporation shall pay any damages caused by the entry, and the logs, lumber or rafts shall be removed within a reasonable time. All logs, lumber or rafts belonging to other parties which may float onto a boom shall be returned to the owners upon proof of ownership. (Smith-Florida)
W70-03412

LANDING AND LOADING FACILITIES.

Tenn Code Ann secs 70-201 thru 70-209 (1956).

Descriptors: *Tennessee, *Transportation, *Navigable waters, *Administrative agencies, Boats, Navigable rivers, Rivers, Streams, Navigation, Communication, Highways, Administration, Inland waterways, River basin development,

Water Law and Institutions—Group 6E

Docks, Regulation, Economics, Public benefits, Legislation, Building codes, Access routes. Identifiers: Landing, Loading, Commerce.

The Commissioner of the Department of Highways and Public Works is authorized to acquire, maintain, and operate any public facilities he may deem suitable for loading and landing cargo wherever state highways intersect or parallel any navigable waters in the state. The Commissioner may perform any acts and make any regulations to carry out the purpose of this act, and is authorized to cooperate with subdivisions and agencies of the state or federal government. The purpose of this chapter is to promote traffic and commerce upon the waters of the state and to aid the United States in improving navigation. Due regard shall be had for the paramount rights of the United States in navigable waters. No owner or operator of any river wharf shall collect any charge for wharfage or landing of boats unless the wharf is in good repair. Failure to keep a wharf in good repair is a misdemeanor. (Smith-Florida)
W70-03414

APPEALS IN DRAINAGE AND LEVEE DISTRICT PROCEEDINGS.

Tenn Code Ann secs 70-1101 thru 70-1109 (1956).

Descriptors: *Tennessee, *Drainage districts, *Judicial decisions, *Adjudication procedure, Legal aspects, Legislation, Levees, Condemnation, Damages, Costs, Jurisdiction, Flood control, Structures, Water law. Identifiers: Appeal procedure.

Any party aggrieved by a decision of the county court in establishing or refusing to establish a drainage or levee district may appeal to the circuit court. An appeal from a judgment of the county court will not prevent further improvement, appropriation, and condemnation if the district posts a security bond payable to the appellant for double the amount of damages claimed. The circuit court shall hear any such appeal de novo. Any new finding of damages in the circuit court shall be entered in the records of the county court. (Schram-Florida)
W70-03417

WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS).

Tenn Code Ann secs 70-1401 thru 70-1432 (1956).

Descriptors: *Tennessee, *Government finance, *Administrative agencies, *Drainage districts, Local governments, Loans, Interest, Assessments, Taxes, Legal aspects, Legislation, Land tenure, Judicial decisions, Economics, Administration, Maintenance, Maintenance costs, Jurisdiction, Levees, Land reclamation. Identifiers: *Bonds.

County courts may authorize the issuance of drainage bonds to fund the reclamation or improvement of drainage areas. The terms of the bonds are to be fixed by the board of directors of the improvement district. The bonds are to be paid by assessments on lands within the district. Bonds for multi-county districts must be approved by each county. Individuals may pay their assessments by tendering bonds to the board of directors. Maintenance and/or administration certificates issued on the bonds or receipts held in that fund will constitute a lien on the land in the district until the assessment is paid. Refunding bonds may also be issued to refund existing bonded indebtedness. Taxes resulting from bonding assessments shall be collected and enforced in the same manner as drainage taxes. The directors of a bonding district may also borrow money to make up deficiencies in collections needed to pay off bonds and interest. Upon default on any bond, a receiver may be ap-

pointed to collect the assessments due to the defaulting district. (Dearing-Florida)
W70-03418

BOATING SAFETY ACT OF 1965.

Tenn Code Ann secs 70-2201 thru 70-2225 (Supp 1969).

Descriptors: *Tennessee, *Boating regulations, *Administrative agencies, *Safety, Recreation, Boats, Accidents, Public health, Equipment, Operation and maintenance, Coordination, State governments, Government finance, Education, Administration, Local governments, Coast guard regulations, Skiing, Buoys, Navigation, Inspection, Jurisdiction, Legal aspects, Judicial decisions, Water sports. Identifiers: Boat registration.

The Tennessee Game and Fish Commission shall enforce this act, the purpose of which is to promote the safety of persons and property in and connected with vessels. The Commission shall establish programs for: (1) public education in boating safety; (2) registration and regulation of vessels; (3) cooperation with other state and federal agencies; and (4) improvement and promotion of the waters for recreational purposes. Vessels other than those specifically exempted must be numbered for identification by the Commission. A Boating Safety Advisory Board is created to advise the Commission on rules and regulations for boating safety. The Commission shall establish rules and regulations governing safety equipment and operation of vessels. The Commission may authorize special aquatic events. Damaging vessels, interfering with navigation aids, and the use of sirens are prohibited. The Commission may license and inspect vessels carrying passengers for hire. Owners are liable for the damage caused by their vessels. (Dearing-Florida)
W70-03423

DRIFTING AND FLOATING TIMBER.

Tenn Code Ann secs 68-102, 68-103 (1956).

Descriptors: *Tennessee, *Lumber, *Aquatic drift, *Compensation, Driftwood, Streams, Rivers, Navigable waters, Boats, Damages, Legislation, Legal aspects.

Timber, whether branded or not, found adrift or floating in any stream or water of this state and which has been prepared for sale without a boom or other arrangement by the owner for the preservation thereof entitles the finder to receive compensation from the owner for as much as he delivers to the owner. The amounts of such compensation are set forth. Any person who takes up and cares for any fleet, raft, or platform of timber shall be entitled to additional compensation. (Smith-Florida)
W70-03426

TELEGRAPH AND TELEPHONES.

Tenn Code Ann secs 65-2101, 65-2105, 65-2106 (1956).

Descriptors: *Tennessee, *Communication, *Navigation, *Transmission, Legislation, Transmission lines, Rivers, Surface waters, Construction, Maintenance, Operation and maintenance, Navigable waters.

Telegraph and telephone corporations can construct telegraph or telephone lines and erect necessary fixtures across, over, or under Tennessee rivers provided the navigation of said waters is not impeded. Any person or corporation organized for the purpose of transmitting intelligence may construct, operate and maintain necessary telegraph, telephone or other lines across and under Tennessee waters. (Powell-Florida)
W70-03427

DUVAL ENGINEERING AND CONTRACTING CO V SALES (RIPARIAN RIGHTS).
77 So2d 431-434 (Fla 1954).

Descriptors: *Florida, *Riparian rights, *Eminent domain, Judicial decisions, State jurisdiction, Ownership of beds, Prescriptive rights, Remedies, Riparian land, Banks, Condemnation, Right-of-way, Beds.

Upland owners sued to enjoin agents of the state from constructing a bridge across a navigable river. Plaintiffs alleged that such construction was either an appropriation of riparian rights or a taking of property which necessitated proceedings in eminent domain. Plaintiffs won on the alternative eminent domain pleading. The state appealed. The supreme court stated that since plaintiff failed to fill in or permanently improve the submerged land continuously from the high water mark in the direction of the channel, the land was therefore subject to reversion and subsequent sale under a statute vesting title in State Road Department. Duval Engineering was therefore lawfully exercising governmental power and respondent was without right to compensation for impairment of riparian rights. (Moulder-Florida)
W70-03563

DRAINAGE DISTRICTS.

For primary bibliographic entry see Field 04A.

W70-03566

WHARVES, DOCKS AND FERRIES.

Pa Stat Ann tit 53, secs 14191, 14193, 14197 (1957).

Descriptors: *Pennsylvania, *Docks, *Piers, *Coastal structures, Bulkheads, Low water mark, High water mark, Legislation, Riparian rights, Easements, Construction, Navigable waters, Administrative agencies, Administrative decisions, Local governments, Marshes, Coastal marshes, Land reclamation, Boats, Navigation, Storage, Basins.

The Director of the Department of Wharves, Docks, and Ferries shall have the power to regulate, fix and establish bulkhead and pierhead lines, and the distance between piers. He may also adopt regulations for the construction, extension, improvement, and repair of wharves, piers, bulkheads, docks, slips and basins. The Director shall have charge of all the wharf storage property belonging to cities of the first class, including all easements, uses, reversions, and rights belonging thereto. The Director shall have authority to purchase, in the name of these cities, such unimproved marshlands as may be reclaimable between the low-water line and the high-water shore-line of the navigable waters. After appropriation of money by the city, the Director may reclaim, fill-in and improve the marsh-lands and construct thereon wharves, piers, docks, slips, basins, and storage facilities. Any land that cannot be improved may be leased or sold. The Director may purchase any coastal structures that are necessary for the purposes of commerce and navigation. He may also purchase, maintain, and operate any boats, launches, ice boats and dredges necessary for the performance of the duties of the Department of Wharves, Docks and Ferries. (Schram-Florida)
W70-03570

TURNPIKE BRIDGE ACROSS THE DELAWARE RIVER.

Pa Stat Ann tit 36, sec 658.2 (1961).

Descriptors: *Pennsylvania, *Bridges, *Highways, Interstate rivers, Interstate compacts, Water resources development, State governments, Water policy, Road construction, Transportation, Bridge construction, Administrative agencies, Administration, New Jersey, Delaware River.

In order to facilitate traffic across the Commonwealth, the Pennsylvania Turnpike Commission is

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

empowered to construct a turnpike from the eastern extension of the turnpike system to a point on or near the Delaware River between Pennsylvania and New Jersey. At that point, the Commission is to construct, operate and maintain a bridge, either alone or in conjunction with the New Jersey Turnpike Authority. The Commission may acquire the use, operation or maintenance of any bridge across the Delaware River heretofore or hereafter constructed, together with connecting roads, tunnels and bridges. (Smith-Florida)
W70-03571

DELAWARE RIVER PORT AUTHORITY (JOINT COMPACT WITH NEW JERSEY).

Pa Stat Ann tit 36, secs 3503, 3504 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Port authorities, *Delaware River, *Interstate compacts, Interstate commissions, Interstate rivers, River basin commissions, Water resources development, State governments, Rivers, Bridges, Bridge construction, Communication, Navigation, Transportation, Eminent domain, Condemnation, Regulation, Cities, Highways, River basin development, Legislation.

Whereas New Jersey and Pennsylvania have a common interest in the development of the Delaware River from Philadelphia and Camden to the sea, and in the operation and regulation of bridges and other forms of communication and trade routes, the Delaware River Joint Commission is continued as the Delaware River Port Authority to effectuate its enumerated purposes. The composition of the Commission is described and its general powers are listed. A limited power of eminent domain is granted, and financial powers and liabilities are described. Various limitations are imposed on the Commission's powers. Rules and regulations are provided for, and policemen for the enforcement thereof may be appointed. (Smith-Florida)
W70-03572

DELAWARE RIVER PORT AUTHORITY (PURPOSES).

Pa Stat Ann tit 36, sec 3503 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Interstate commissions, *Delaware River, *Interstate compacts, Interstate rivers, River basin commissions, Water resources development, Rivers, Bridges, Bridge construction, Transportation, Communication, Tunnels, Tunnel construction, Harbors, Eminent domain, Condemnation, Regulation, Cities, Highways, River basin development, Port authorities.

The Delaware River Port Authority is (1) to operate, maintain and improve the bridge between Camden and Philadelphia; (2) to establish and operate facilities for passenger transportation across bridges or tunnels controlled by the Commission; (3) to improve the Port District for port purposes; (4) to cooperate with other bodies interested in the Delaware River and Port District; (5) to construct bridges and tunnels across or under the Delaware River; (6) to promote the Delaware River as a highway of commerce; and (7) to make studies and recommendations for the improvement of commerce facilities on the Delaware River. For its authorized purposes the Commission is empowered to: (1) have legal existence with all the rights and liabilities thereto; (2) exercise eminent domain in the Port District; (3) determine the location and character of all improvements or facilities within its jurisdiction; and (4) acquire and operate any project or facility of commerce. (Smith-Florida)
W70-03573

DELAWARE RIVER PORT AUTHORITY (REVENUE).

Pa Stat Ann tit 36, secs 3503, 3504 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Interstate commissions, *Delaware River, *Interstate compacts, Interstate rivers, River basin commissions, River basin development, Water resources development, Rivers, Bridges, Bridge construction, Communication, Navigation, Transportation, Eminent domain, Regulation, Cities, Tunnels, Tunnel construction, Legislation.

The control, operation and collection of tolls and other revenue of the existing bridge across the Delaware River belong to the Commission, but the Commission is liable to Pennsylvania, New Jersey and Philadelphia for certain named moneys. The Commission is authorized to make and enforce such rules and regulations and to collect such tolls and other charges in connection with properties it controls as it may deem necessary or proper. The Commission shall make annual reports to the member states. The Commission upon written consent of the Governors, is empowered to acquire the Tacony-Palmyra Bridge with any approaches thereto. The Commission shall not erect any new facility without prior approval of the Governors of both states. Certain local limitations on bridge and tunnel construction are imposed. The Commission is empowered to construct and operate a bridge or tunnel for vehicular traffic at named locations and to exercise eminent domain to obtain private or public property for such projects. The Commission is empowered to construct, rehabilitate and operate ferries across the Delaware River within the Port District. Public utilities' rights of way shall be relocated if condemned by the Commission. (Smith-Florida)
W70-03574

REMOVAL OF MILLDAMS.

Ohio Rev Code Ann secs 6155.01 thru 6155.13 (Page 1953).

Descriptors: *Ohio, *Milddams, *Administrative agencies, Assessments, Streams, Water supply, Benefits, Costs, Legal aspects, Public health, Damages, Land tenure, Cost allocation, Local governments, Structures.

Identifiers: *Passage of water, Removal.

Procedures required for the removal of milddams are described. Two-thirds of the affected landowners must file a petition with the county auditor and a surety bond to pay expenses if the county board of commissioners refuses the petition. Notice of hearings is required. The board of commissioners shall view the premises and shall determine if the improvement and removal of the milddam is conducive to public health, convenience, or welfare. If it grants the petition, the board shall negotiate for the purchase of the milddam. The board shall equitably apportion the costs of purchase and removal to each of the petitioners and landowners benefited by the removal. Upon failure to agree with an owner of a milddam, application for damages may be made. Real estate of the benefited landowners shall be assessed to pay the costs of removal. (Duss-Florida)
W70-03576

MUNICIPAL CORPORATIONS (PUBLIC SERVICES).

Ohio Rev Code Ann secs 735.02, 735.32 (Page 1953).

Descriptors: *Ohio, *Cities, *Public utilities, *Maintenance, Legislation, Local governments, Projects, City planning, Administration, Utilities, Roads, Engineering personnel, Repairing, Mechanical engineering, Sewers, Drains, Ditches, Streams, Sewage, Construction, Administrative agencies, Legal aspects, Water management (Applied), Channels, Water courses (Legal).

The director of public service manages and supervises all public works of the city. The director supervises the improvement and repair of wharves, docks, landings, bridges, aqueducts, sewers, drains, ditches, culverts, ship channels, streams, and

watercourses. The director manages municipal water undertakings of the city and sewage disposal plants. The street commissioner, or an engineer, if provided, supervises the improvement of streets and other enumerated activities. (Powell-Florida)
W70-03579

PUBLIC UTILITIES AND CARRIERS.

Tenn Code Ann secs 65-2201 thru 65-2204 (1956).

Descriptors: *Tennessee, *Public utilities, *Dams, *Navigable waters, Legislation, Construction, Eminent domain, Streams, Rivers, Water consumption, Industrial water, Domestic water, Water control, Hydroelectric plants, Water works, Water conveyance, Electric power production, Navigation, Boats, Canals, Reservoirs, Ponds, Locks, Sluices, Diversions, Legal aspects.

Identifiers: *Sluiceway.

Gas and electric corporations furnishing light, heat, and power generated or produced from stream power or water power obtained by a dam across any stream of water have the power of eminent domain. They may use, employ, and divert necessary water flowing in and running into a stream or watercourse. They may also use lands necessary in establishing and maintaining their power houses, canals, flumes, conduits, pipelines, reservoirs, ponds, and dams. A sluiceway, lock or other fixture sufficient to permit logs, timber, lumber, and boats to pass around, through or over a dam must be maintained in connection with the corporation's dam in navigable waters. Plans and details for work on dams in navigable waters must be submitted to the Secretary of the Army for his approval before work is commenced. Construction in navigable waters is subject to the supervision and approval of the Engineer Officer of the United States Army in charge of the locality. (Powell-Florida)
W70-03586

WATER AND WATERWORKS COMPANIES.

Tenn Code Ann secs 65-2701 thru 65-2704, 65-2709 (1956).

Descriptors: *Tennessee, *Public utilities, *Condemnation, *Water pollution, Eminent domain, Legal aspects, Legislation, Cost repayment, Right-of-way, Condemnation value, Water control, Water conveyance, Watercourses (Legal), Streams, Riparian rights, Domestic water, Municipal water, Riparian land, Riparian waters, Canals, Conduits, Ponds, Dams, Reservoirs, Water consumption (Excludes consumptive use), Water allocation (Policy), Water distribution (Applied), Environmental sanitation.

Any water company is empowered to acquire, by purchase, condemnation, or other proper method, the right to use and divert the necessary water flowing and running into any stream or watercourse. The water company may also take land, water, riparian rights and rights-of-way necessary for establishing and maintaining its power houses, canals, flumes, conduits, pipelines, ponds, dams, reservoirs, and other works. Water companies, incorporated under Tennessee laws and having contracts to supply water to public charitable institutions may condemn springs, creeks, waters and riparian rights for the purpose of furnishing such water supply. The water company must compensate the owners for property condemned and may give a bond pending assessment of damages resulting from condemnation of water or rights. It is unlawful to corrupt any stream or reservoir used by a corporation for water supply. (Powell-Florida)
W70-03587

DIVISION OF WILDLIFE.

Ohio Rev Code Ann secs 1531.06, 1531.07, 1531.11, 1531.14, 1531.15, 1531.24 (Page 1964), as amended, (Supp 1970), sec 1531.29 (Page Supp 1970).

Descriptors: *Ohio, *Natural resources, *Wildlife management, *Wildlife conservation, Legislation, Legal aspects, Water rights, Water conservation, Wastes, Water pollution control, Fish hatcheries, Regulation, Recreation, Fishing, Streams, Lakes, Reservoirs, Clams, Mussels, Crayfish, Fish, Frogs, Turtles, Investigations, Ponds, Rivers, United States, Wildlife, Water resources development, Fish stocking.

The Chief of the Division of Wildlife may acquire lands or surface rights upon lands or waters for wildlife management, preservation and propagation, and for outdoor activities such as hunting and fishing. The Chief is empowered to make regulations to protect these acquisitions from pollution and waste and to provide for the taking of wildlife on the acquired property. All lakes, reservoirs, and state lands dedicated to public recreational use will be placed under the supervision and control of the Chief. No person may take, possess, buy, or sell any clams, mussels, crayfish, fish, or frogs contrary to a Division regulation. Employees of the Division may enter upon private land to conduct fish or game research, fish restoration, or fish restocking. The Division may take fish at any time or place and in any manner stock hatcheries, ponds, lakes, or rivers, or exterminate rough fish. The Division may set aside any waters for the propagation of fish. The United States Commissioner of Fisheries may operate and maintain fish hatcheries within the state. He may conduct investigations and fish cultural operations. No person may discharge garbage, rubbish, or other unsightly or unsanitary wastes into any state owned or controlled watercourse. This section does not apply either to discharge of wastes under authority of a valid permit, or to pollution of waters which do not join natural surface or underground waters. (Keith-Florida)
W70-03588

BRIDGE COMPANIES (CONSTRUCTION OF BRIDGES AND INTERFERENCE WITH NAVIGATION).

Tenn Code Ann sec 54-1803 (1968).

Descriptors: *Tennessee, *Bridges, *Bridge design, *Navigation, Design standards, Navigable waters, Streams, Boats, Structures, Construction, Legislation, Bridge construction, Standards.

Identifiers: Obstruction to navigation.

Bridge companies may adopt design standards and specifications to insure that bridges shall be safely built and suitable for the intended traffic. Bridges across navigable streams shall not necessarily interfere with navigation, and shall have enough draw or be sufficiently high to allow the passage of boats under them. (Duss-Florida)
W70-03589

GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION).

Tenn Code Ann secs 51-101 thru 51-121 (1966).

Descriptors: *Tennessee, *Administrative agencies, *Fish, *Fish management, Fish conservation, Fish hatcheries, Commercial fishing, Fish stocking, Bodies of water, Ponds, Fishing, Fisheries, Regulation, Legislation, Financing, Wildlife conservation, Wildlife management, Game birds, Fur-bearing animals, Hunting, Conservation, Wildlife.

Identifiers: *Fish propagation, *Preserves, Reservations, Nursery ponds, Penalties (Criminal).

The State Game and Fish Commission is herein created. The operation of the Commission is provided. The Governor shall appoint Commissioners. The Commission has full and exclusive jurisdiction of the duties and functions relating to fish, game, and wildlife. It is the Commission's duty to protect, propagate and preserve game, fish, fur-bearing animals and wildlife of the state. The Commission is authorized to acquire lands and waters suitable for; fish hatcheries, nursery ponds, or game farms; animal restoration, propagation, protection or management; and public hunting, fishing, or

trapping areas. The Commission may acquire species of animals for these purposes and control undesirable species. It may enter into cooperative agreements with landowners to further wildlife management. It may enter into agreements with educational institutions and other governmental agencies to promote wildlife management and conservation. Procedures are outlined for the appointment and compensation of a Director for the Commission and of personnel needed for the administration of game and fish laws. The powers and duties of these officers are described. Financing of the various activities of the Commission and its personnel is described. (Duss-Florida) .
W70-03590

HEALTH AND SAFETY (MALARIA).

Tenn Code Ann secs 53-801 thru 53-809 (1966).

Descriptors: *Tennessee, *Impounded waters, *Mosquitoes, *Public health, Permits, Impoundments, State governments, Legislation, Administration, Administrative agencies, Regulation, Diseases, Bayous, Afterbays, Obstruction to flow, Aedes species.

Identifiers: Nuisances.

Impounded water is defined as a body of water of less than one acre which has collected under other than natural conditions. Any person proposing to impound water must obtain a permit for impoundage construction from the Commissioner of the State Department of Public Health. Application is to be made upon a special form, accompanied with a description of the project, its purpose, location and a plat of the general area. Application to permit actual impoundage of water must be made to the Commissioner after construction is complete. The Commissioner shall make rules and regulations regarding impounded water to be carried out by those responsible for the impounded area. The Commissioner must inspect impounded waters to see if such is conducive to the breeding of malaria or other disease-carrying mosquitoes. If conducive to such breeding, the condition must be corrected by the one responsible for the impoundage area. Failure to do so is a misdemeanor and punishable by fine. If convicted three times for violation of this act, the impounded area may be abated as a nuisance at the cost of the owner. (Barnett-Florida)
W70-03591

PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES).

For primary bibliographic entry see Field 04A.

W70-03592

CRIMINAL OFFENSES: ARSON AND FRAUD.

Tenn Code Ann secs 39-504, 39-1908, 39-1909 (1956).

Descriptors: *Tennessee, *Bridges, *Vessels, *Insurance, Legal aspects.

It is a felony to willfully and maliciously burn any bridge or watercraft. (Dearing-Florida)
W70-03593

WATERS AND WATERCOURSES: CRIMINAL OFFENSES.

Tenn Code Ann secs 2205, 2206 (1956).

Descriptors: *Tennessee, *Water works, *Water pollution, *Legal aspects, Pipes, Pumps, Reservoirs, Streams, Equipment, Domestic water, Industrial water, Standpipes, Water supply, Legislation.

It is a misdemeanor to: willfully injure the pipes, pumps, reservoirs, tanks, or other apparatus of any waterworks; disturb or pollute the waters of any waterworks by any willful acts; or to pollute any stream supplying water to any such water plant. (Dearing-Florida)

W70-03594

CRIMINAL OFFENSES: NUISANCES.

Tenn Code Ann secs 39-2901, 39-2904 (1956).

Descriptors: *Tennessee, *Obstruction to flow, *Water pollution, *Legal aspects, Navigation, Rivers, Streams, Ponds, Water pollution effects, Water pollution sources, Legislation, Navigable waters, Pollutants.

Identifiers: Obstruction to navigation, Nuisance.

It is a public nuisance to: (1) obstruct or impede the passage of any navigable river or collection of water; (2) cause any filth or noisome substance to collect or remain in any place to the prejudice of others; or (3) to corrupt or render impure the water of any river, stream or pond. (Dearing-Florida)
W70-03595

WATERS AND WATERCOURSES: CRIMINAL OFFENSES.

Tenn Code Ann secs 39-4214, 39-4215 (1956).

Descriptors: *Tennessee, *Fishing gear, *Conduits, *Legal aspects, Fish, Nets, Commercial fishing, Pipes, Water works, Permits, Fishing, Regulation, Legislation.

Identifiers: Penalties (Criminal).

Tampering with, or removing fish from any fishing device of another is declared to be a misdemeanor. It is also a misdemeanor to make any tap or connection with any water main or pipes without first obtaining a written permit from the owner. (Dearing-Florida)
W70-03596

WATERS AND WATERCOURSES: CRIMINAL OFFENSES.

Tenn Coade Ann secs 39-4801 thru 39-4811 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Legal aspects, *Regulation, *Structures, Springs, Wells, Ponds, Reservoirs, Canals, Dams, Docks, Water works, Bridges, Water conveyance, Culverts, Navigation, Channels, Surveys, Pipes, Vessels, Levees, Watercourses, Withdrawal, Legislation, Navigation, United States, Floods, Flooding.

Identifiers: *Causeways, United States Coast and Geodetic Survey, Penalties (Criminal), Penalties (Civil), Obstruction to navigation.

The following acts are declared to be misdemeanors: (1) to injure any spring, well, or water used by any worshipping assembly or belonging to another person; (2) to maliciously draw off the water from another's millpond, reservoir, canal, trench or pond; (3) to maliciously injure any dam, lock, canal, trench, reservoir or waterworks; (4) to maliciously destroy another's fixtures for the conveyance of water; (5) to interfere with any navigation structure, or to erect or maintain an obstruction to navigation; (6) to injure or remove any property of the United States Coast and Geodetic Survey; (7) to maliciously injure or let loose any vessel of another; (8) to travel on any levees except as designated for public travel; or (9) to maliciously injure any bridge, causeway, or tollgate. It is a felony to cut or to produce a break in a levee so as to flood protected lands. It is further declared a major misdemeanor to fraudulently tamper with serial numbers on boats or to knowingly buy, sell, or possess a boat whose serial numbers have been tampered with. Civil liability is also provided for various of the above offenses. (Dearing-Florida)
W70-03597

NATIONAL FORESTS, PARKS AND DEVELOPMENT PROJECTS.

Tenn Code Ann secs 11-1001 thru 11-1006 (1956).

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Tennessee, *Federal government, *Tennessee River, *National forests, Legal aspects, Legislation, Projects, Parks, Land use, Streams, Bridges, Boats, State governments, Land, River basins, State jurisdiction, Administrative agencies, Eminent domain, Compensation.
Identifiers: Tennessee River Basin.

The United States is authorized to acquire such land as the federal government, the State Forester, and the Governor consider necessary for the establishment and extension of national forests and parks and the improvement and development of the Tennessee River Basin. The state of Tennessee retains its title, ownership and jurisdiction over all bridges, ferries, and streams and the right to locate, relocate and reconstruct bridges and ferries over such streams. Federal agencies acquiring lands for public improvement have no right to destroy or impair the use of any bridge or ferry without first compensating the owner thereof. (Powell-Florida)
W70-03598

LAND FOR INSTITUTIONAL WATER OR SEWAGE SYSTEM.

Tenn Code Ann sec 12-109 (1956).

Descriptors: *Tennessee, *Riparian rights, *Water rights, *Administrative agencies, Legal aspects, State governments, Land use, Legislation, Pipelines, Water supply, Drainage systems, Land, Sewage systems, Institutions, Water works, Condemnation, Easements, Right-of-way.

The state of Tennessee, acting through the department or agency supervising penal, charitable, reformatory, or educational institutions, may acquire all necessary land with interests therein, including flowage rights, rights of riparian owners on any Tennessee stream and easements for water works or sewage disposal pipe lines for the use of such institution. (Powell-Florida)
W70-03599

CONCURRENT JURISDICTION OF THE MISSISSIPPI RIVER.

Tenn Code Ann secs 4-102, 4-103 (1956).

Descriptors: *Tennessee, *Boundaries (Property), *Jurisdiction, *Mississippi River, Legislation, Missouri, Arkansas, Legal aspects, Rivers, State jurisdiction, Meanders, Banks, Boundary disputes, Supervisory control (Power), Water rights, Political aspects.
Identifiers: Concurrent jurisdiction.

Tennessee has concurrent jurisdiction over the waters of any river which forms a common boundary with another state. The criminal jurisdiction of the state of Tennessee is extended to the west bank of the Mississippi River and extends across the Mississippi River where it flows parallel to the boundary of Tennessee. Thus, the states of Tennessee, Arkansas, and Missouri have concurrent criminal jurisdiction over those parts of the Mississippi River which lie opposite them. This section shall become effective as to the states of Arkansas and Missouri when these states pass similar legislation. (Schram-Florida)
W70-03600

JURISDICTION OVER BOUNDARY WATERS.

Tenn Code Ann sec 5-102 (1956).

Descriptors: *Tennessee, *Jurisdiction, *Boundaries (Property), *Legal aspects, Water law, Legislation, Local governments, Watercourses (Legal), Streams, Boundary disputes, Bodies of water, Ownership of beds, Supervisory control (Power), Water rights.
Identifiers: *Concurrent jurisdiction.

Counties that are bounded by a stream or other waters shall have concurrent jurisdiction over the

whole of the waters lying between them. (Schram-Florida)
W70-03601

SUPERVISION OF LOCAL IMPROVEMENTS.

Tenn Code Ann sec 5-521 (1956).

Descriptors: *Tennessee, *Local governments, *Roads, *Watercourses (Legal), Legislation, Road construction, Construction, Maintenance, Supervisory control (Power), Legal aspects, Jurisdiction, Repairing.
Identifiers: *Ferries, *Improvements.

The establishment and general supervision of roads and ferries, watercourses, and local improvements are intrusted to the county court and are county purposes. (Schram-Florida)
W70-03602

BRIDGES AND CROSSINGS.

Tenn Stat Ann secs 229.150, 229.160 (1952).

Descriptors: *Missouri, *Bridges, *Highways, *Ditches, Drains, Legislation, Administrative agencies, Drainage, Damages, Construction, Maintenance, Right-of-way, Landscaping, Shrubs, Vegetation establishment, Drainage water.

All driveways or crossings over ditches connecting highways with private property shall be made under the supervision of the overseer or commissioners of the road districts. It is a punishable misdemeanor for any person to willfully obstruct or damage any public road by: (1) obstructing the side, cross drainage, or ditches; (2) turning water upon such road or right-of-way; (3) depositing any refuse or debris on any public road or in adjacent ditches; (4) planting any hedge or erecting any advertising sign within the lines established for such roads. The road overseer or county highway engineer who finds any road so obstructed shall notify the violator to remove the obstruction. Operators of threshing machines, sawmills, and tractors when crossing public bridges are required to lay down planks not less than one foot wide and three inches thick on the floor of the bridge. (Schram-Florida)
W70-03605

CONSTRUCTION AND MAINTENANCE OF BRIDGES.

Tenn Stat Ann secs 231.220, 231.230 (1952).

Descriptors: *Missouri, *Bridges, *Local governments, *Bridge construction, Maintenance, Repairing, Bids, Contracts, Costs, Construction, Legislation, Structures, Engineering structures, Roads, Supervisory control (Power).

The township board of directors shall construct and repair all bridges in their district costing less than one hundred dollars. They shall make all necessary repairs costing less than twenty-five dollars upon bridges that are built within the township. Whenever it is necessary for the board to build a bridge which will cost more than twenty-five dollars, the board may advertise for bids by giving notice. Whenever it is necessary for any township to build a bridge costing more than one hundred dollars, the township board of directors shall present a certified statement of the amount necessary for construction to the county court. If deemed proper, the county court shall cause the bridge to be built by contract as provided by law. (Schram-Florida)
W70-03607

BRIDGES (CONSTRUCTION OF BRIDGES BY COUNTY COURTS).

Tenn Stat Ann secs 234.010 thru 234.090 (1952).

Descriptors: *Missouri, *Bridges, *Bridge construction, Local governments, Culverts, Concrete construction, Repairing, Maintenance, Supervisory

control (Power), Administrative agencies, Legislation, Damages, Compensation, Financing, Costs, Participating funds, Bridge failure, Taxes, Assessments, Construction costs, Rivers, Streams, Highways.

Each county court shall determine whether the county court or road districts shall build and maintain bridges. The construction of all masonry or concrete culverts and bridges and all bridges costing more than fifty dollars shall be under the supervision of the county highway engineer. Whenever a county bridge is badly damaged by floods or becomes dangerous to public travel, the county highway engineer, with the consent of one or more county judges, may contract to have the bridge repaired. The county court shall allow a reasonable compensation for such repairs. The control and management of toll bridges and roads constructed by now defunct corporations shall be vested in the local county court. Taxpayers may petition for the construction of bridges in any township. County courts may unite for the purpose of building bridges beneficial to the adjoining counties. The procedure for building bridges uniting counties is provided. The procedures for constructing and financing bridges between Missouri and adjoining states are detailed. (Schram-Florida)
W70-03608

ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS.

Booz-Allen and Hamilton, Inc., Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-03611

A UNITED STATES POLICY FOR THE WET FRONTIER,
Theodore F. Stevens.
Nat Res Lawyer, Vol 2, No 4, p 347-351, Nov 1969. 5 p.

Descriptors: *Continental shelf, *Continental slope, *Law of the sea, *United States, Marine geology, Legal aspects, Easements, Federal jurisdiction, International law, Commercial fishing, Boundaries (Property), Water resources, Mineralogy, Fishing, United Nations, Oceans, Oil fields, Exploration, Federal government.

Suggestions are offered for modifying the United States' present policy regarding use of offshore resources. This policy rests upon an interpretation of findings made by the 1958 Geneva Convention on the Continental Shelf. Present United States' policy is considered to be too restrictive. It is urged that American jurisdiction should extend to the limits of the 'continental terrace', which includes the continental slope as well as the continental shelf. The United States should assert exclusive jurisdiction over submarine mineral development and over management and disposition of sea food resources within the limits of the terrace. The United States has adopted United Nations' guidelines which give sovereign rights to a coastal nation for limited exploration and exploitation of an area outside the territorial sea extending to a depth of 200 meters. It is concluded that the United States ought to have this definition of the exploitability modified to embrace the entire continental terrace. It is further concluded that it is in the best interests of the United States to claim exclusive fishery rights in the waters superjacent to the continental terrace and to seek international recognition of this claim. (Barnett-Florida)
W70-03627

WATER RESOURCES (APPROPRIATION OF WATER RESOURCES AND RIGHTS).
Miss Code Ann secs 5956-01 thru 5956-08, 5956-10 thru 5956-24 (Supp 1968).

Water Law and Institutions—Group 6E

Descriptors: *Mississippi, *Appropriation, *Beneficial use, *Prior appropriation, Legal aspects, Administration, Administrative agencies, State governments, Water rights, Preferences (Water rights), Relative rights, Alteration of flow, Diversion, Water users, Dams, Reservoirs, Water levels, Diversion dams, Interstate compacts, Surface waters, Water conservation, Water utilization, Permits, Legislation, Water districts.

To conserve and to put the water resources of Mississippi to their highest beneficial use, all natural bodies of water are made subject to appropriation and placed under the control and development of the state. The Mississippi Board of Water Commissioners is created to administer the act which deals with: (1) the definition, acquisition, and termination of water rights; (2) application for appropriation of water; (3) the employment of a water engineer; (4) powers and duties of the Board; (5) inventory of water resources; (6) cooperation of the Board with other agencies; (7) creation of water districts; (8) unappropriated waters; (9) applications for permits to acquire appropriate rights and to construct appropriation diversion works; (10) construction of dams and reservoirs; (11) compacts and agreements; (12) surveys; and (13) diversion of watercourses. Surface water, domestic uses, municipal use, beneficial use, appropriator, appropriation, watercourse, established average minimum flow, and established average minimum lake levels are defined. (Marsee-Florida)
W70-03635

WATER RESOURCES (BOARD OF WATER COMMISSIONERS).

Miss Code Ann secs 5956-01 thru 5956-08, 5956-10 thru 5956-14 (Supp 1968).

Descriptors: *Mississippi, *Appropriation, *Administrative agencies, *Beneficial use, Prior appropriation, Legal aspects, Administration, State governments, Water rights, Preferences (Water rights), Relative rights, Water users, Dams, Water levels, Surface waters, Water conservation, Water utilization, Leadership, Domestic water, Spring waters, Water districts.

All natural bodies of water are subject to appropriation and placed under the control and development of the state. However, ground or subterranean water rights or usage are not affected. No right to appropriate or use water subject to appropriation shall be acquired except upon compliance with this act. However, nothing herein shall interfere with the customary use of water for domestic purposes nor prevent a landowner from using a spring arising on his land. Moreover, any person may construct a dam across streams having the minimum flow specified herein. Water appropriation shall be equal to other property rights and may only be terminated as provided herein. To administer this act a Board of Water Commissioners is created. Its powers and duties shall be to: (1) employ a water engineer; (2) cooperate with other agencies; (3) inventory water resources; (4) establish the rights of present beneficial water users; and (5) divide the state into water districts. Surface water, appropriation, watercourse and domestic use are defined. (Marsee-Florida)
W70-03636

WATER RESOURCES (APPLICATIONS TO APPROPRIATE).

Miss Code Ann secs 5956.15-5956.24 (Supp 1968).

Descriptors: *Mississippi, *Appropriation, *Administrative agencies, *Beneficial use, Prior appropriation, Legal aspects, Administration, State governments, Water rights, Preferences (Water rights), Relative rights, Alteration of flow, Diversion, Water users, Dams, Reservoirs, Diversion dams, Interstate compacts, Surface waters, Water conservation, Water utilization, Permits, Watercourses (Legal), Legislation, Water districts.

An application must be made to the Board of Water Commissioners in order to acquire an appropriate right to any surface streams, lakes, or other watercourses of Mississippi for beneficial use. Upon examining the maps, plats and other information filed with the application, the Board may approve the same and issue a permit authorizing the construction of diversion works to perfect the appropriation. Persons desiring to construct dams or reservoirs on any watercourse specified herein must obtain a written statement from the Board that such construction will not affect plans for the proper utilization of the water resources of the state. The Board may also: (1) enter into compacts and agreements concerning interstate watercourses; (2) enter upon lands to make surveys; and (3) regulate the diversion of watercourses. The Board shall aid in the distribution of water in accordance with court orders. (Marsee-Florida)
W70-03637

FISH TRAPS: LICENSING AND REGULATION.

R I Gen Laws Ann secs 20-18-2 thru 20-18-20 (1968).

Descriptors: *Rhode Island, *Fishing gear, *Commercial fishing, *Trapping, Fish, Fishing, Permits, Equipment, Legal aspects, Administrative agencies, State governments, Jurisdiction, Regulation, Wildlife management, Water conservation, Inspection, Nets, Weirs, Fish harvest, Legislation, Control, Fish conservation, Fish management.
Identifiers: *Fish traps.

Provisions of this act regulate the use of fish traps in Rhode Island waters and govern the licensing of persons erecting or maintaining such traps. The Director of Natural Resources is empowered to make rules and regulations concerning fish traps and to control the issuance of licenses. The superior court is given jurisdiction to enforce the provisions of this act and the regulations promulgated by the Director. 'Fish trap' includes floating traps, weirs, pounds, nets, or other devices to catch fish. (Marsee-Florida)
W70-03638

SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES.

Pa Stat Ann tit 30, secs 431-438, 441, 461 (1958).

Descriptors: *Pennsylvania, *Delaware River, *Permits, *Fish conservation, Regulation, Fishing gear, Nets, Fyke nets, Gill nets, Trapping, Legislation, Legal aspects, State governments, Fish, Administrative agencies, Interstate compacts, Federal government, New York, Delaware, New Jersey, Fishing, Rivers, Bays, Tributaries, Fish management.
Identifiers: *Shad fishing.

In accordance with the purposes of the Atlantic States Marine Fisheries Compact and in order to restore shad in the Delaware River, this act establishes a license system designed to control increases in fishing pressures in the Delaware. Licensing procedures are set forth. Only the fishing gear designated herein may be used to take shad in the Delaware River, Delaware Bay, and their tributaries. Permitted gear is regulated and includes the following: (1) haul seines; (2) fyke or hoop nets; (3) stake gill nets, either stake or anchored; (4) drift gill nets; and (5) hand lines, including rod and reel. Closed seasons are established, and the location of nets governed. The Pennsylvania Fish Commission is authorized to confer with New York, New Jersey, Pennsylvania, and Delaware officials and may enter agreements with respect to the coordination of research, enforcement, and other operations necessary to joint shad management. The Pennsylvania Fish Commission is authorized and directed to cooperate with the federal government in those fish restoration and management projects contemplated by specified act of the United States Congress. (Marsee-Florida)
W70-03639

DAMS AND BRIDGES (PROCEDURES REGARDING WATER POWER PERMITS).

Wis Stat Ann secs 31.095-31.17 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Dam construction, *Bridges, Administrative agencies, Legislation, State governments, Local governments, Electric power, Powerplants, Hydroelectric plants, Regulation, Boundaries (Property), Operation and maintenance, Utilities, Dams, Resources, Public utilities, Reservoirs.

Acquiescence to rates set by the Department of Resources Development and the Public Service Commission for electric power distributed to users within the state is a condition precedent to the issuance of a water power permit. Permits will be void unless the dams which they authorize are completed within five years. Necessary and reasonable two-year extensions may be given. The grantee of a permit must submit a map and profile of the plans and specifications of the structure to the Department. The Department may reject, modify, or approve such plans. A verified statement of compliance with those plans must be submitted to the Department within ten days of the dam's completion. With the Department's permission, existing dams may be raised or enlarged. No permit will be granted when there is no proof of ability to operate and maintain the proposed dam or if objections are filed by the municipalities in which the dam is to be located. Existing dams may be acquired by any corporation engaged in the business of furnishing power to the public. (Barrett-Florida)
W70-03640

PUBLIC DOMAIN AND TRUST FUNDS (DAMS AND BRIDGES).

Wis Stat Ann secs 31.18-31.26 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Bridges, *Dams, Hydroelectric power, Administrative agencies, State governments, Legislation, Local governments, Legal aspects, Navigable waters, Non-navigable waters, Sluices, Dam construction, Dam failure, Hydraulic structures, Hydroelectric plants, Regulation, Inspection, Navigation, Detention reservoirs, Safety, Operation and maintenance.
Identifiers: Nuisances.

Various obligations with regard to public safety and convenience must be met by those who own and operate bridges and dams within the state. Any action concerning construction, operation, and maintenance of these structures is subject to prior permission of the Department of Resources Development. Dams capable of producing a minimum of 750 horsepower shall be inspected yearly. At other times, inspections shall be made upon allegations by a mayor or village president that a dam or reservoir is unsafe and a danger to the public. An annual inspection fee shall be paid by bridge and dam owners. Transfers of permits are controlled by the Department and the duration of contracts under such permits for the distribution of power is limited. Any dam maintained as an unlawful combination to restrict hydroelectric power may be taken over by the state through receivership proceedings. Private citizens may build bridges on navigable waters with the permission of the Department. Bridges and dams not built in accord with this act are public nuisances. Liens may be imposed upon bridges and their approaches to secure judgments obtained as a result of damage caused by their operation. (Barnett-Florida)
W70-03641

HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS).

Wis Stat Ann secs 86.20-86.23 (1957), as amended, (Supp 1969).

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Descriptors: *Wisconsin, *Bridge construction, *Bridges, *Boundaries (Property), Legislation, Local governments, Abutments, Piers, Railroads, State governments, Navigable waters, Interstate rivers, Rivers, Legal aspects, Condemnation, Administrative agencies, Financing, Cities, Public utilities, Transportation.
Identifiers: *Toll bridges, Approaches.

Any corporation authorized by Congress to build and maintain a bridge over navigable boundary waters of Wisconsin shall have all the rights and powers, with respect to entry and acquisition of real estate, that railroad corporations now possess. Any county, town, or village bordering navigable waters which form a boundary line of this state may construct a foot and vehicular toll bridge across such waters. The governing bodies of such municipalities must adopt a resolution authorizing such construction and specifying the method of financing. Financing may be either through the proceeds of bonds, taxation, or from the general fund. Twenty percent of the electorate may file a petition requesting that the question of acquisition of such toll bridges be submitted to them. Bonds are to be repaid solely from the revenues of bridge operation. For purposes of management, two or more bridges may be combined as a single public utility. Any bridge corporation franchised to construct, operate, or maintain a railroad bridge or a passageway across waters forming a boundary line of this state must maintain such bridge in accessible condition with serviceable approaches. All swing or drawbridges built jointly by two municipalities shall be maintained by each in proportion to the cost of construction borne by each. (Barnett-Florida)
W70-03642

6F. Nonstructural Alternatives

LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,

Lincoln City-Lancaster County Planning Commission, Nebr.

James H. Schroeder.

In: Flood Plain Management, Iowa's Experience, ed. by Merwin D. Dougal (Ames, Iowa: Iowa State University Press, 1960), Chapter 20, p 237-245. 1 fig, 3 ref.

Descriptors: *Flood plains, *Regulation, Management, Flood plain zoning, Utilities, City planning, Multiple-purpose projects, Parks, Watershed management, Administration.

In the past eight years much has been done in the form of corrective and preventive flood measures within the Lincoln area. Comprehensive plans developed in 1952 and in 1960 have recognized the flood problem. The 1960 comprehensive plan pertains both to the city area and to the whole of Lancaster County. It includes limiting the development allowed in the flood plain area. This is done in two ways: (1) lands which lie in the flood plains are designated to be part of the community's park system, and (2) where it is not possible to include the land in the park system, the development of the land within the flood plain is kept at an absolute minimum. Lincoln enforces the latter by controlling the expansion of municipal utilities, i.e. not expanding utilities into areas subject to inundation by the 100 year flood. In addition, corrective flood control measures have been installed. Lincoln is included in the Salt Creek Watershed District formed in 1960 and has benefited from the construction of nine large dams, and channel improvements along Salt Creek. The author emphasizes the need for public and administrative cooperation, sound technical planning and public support to implement a successful comprehensive program for a city. (Marriott-Chicago)
W70-03341

THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,

Commissioner of Parks and Public Property, Cedar Rapids, Iowa.

Donald K. Gardner.

In: Flood Plain Management, Iowa's Experience, ed. by Merwin D. Dougal (Ames, Iowa: Iowa State University Press, 1969), Chapter 12, p 137-146. 4 fig, 12 ref.

Descriptors: *Flood plains, *Management, *Parks, *Flood control, Multiple-purpose projects, Non-structured alternatives, Recreation facilities, Water sports, Golf courses, Water resources development, Preservation.
Identifiers: *Open space, *Cedar Rapids, (Iowa).

Using Cedar Rapids, Iowa as an example this article emphasizes the need for a balanced allocation of land use in urban areas, and the compatibility of open-space needs with concepts of optimum flood plain utilization and minimum flood plain occupancy. It is accepted that open-space is necessary for parks and recreational facilities. Flood plains provide open space, good recreation possibilities, are cheaper to acquire than other land sites, and create hazardous situations when used for industry, commerce and housing. A program is proposed which would include acquisition of a greenbelt which would encompass at least the design floodway, natural or improved, covering an area of twenty-five miles and 2,000 to 3,000 acres of land. Where high population densities were anticipated, this greenbelt would be expanded to include areas for playgrounds, athletic uses and major picnic centers. Some of these uses have been experimented with already with good results. Special studies of the three creeks which affect the city have been made so that the city administration has sufficient information in formulation of flood plain policy. Other aids in an open-space program are the Department of Housing and Urban Development and the Land and Water Conservation Fund program of the Department of Interior Bureau of Outdoor Recreation. (Marriott-Chicago)
W70-03342

EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA),

Geological Survey, Harrisburg, Pa.

For primary bibliographic entry see Field 02E.
W70-03458

6G. Ecologic Impact of Water Development

WATER AND MAN: A WORLD VIEW,

Geological Survey, Washington, D.C. Water Resources Div.

Raymond L. Nace.

Paris, France, UNESCO, 1969. 46 p, 7 photo.

Descriptors: *Water resources development, *International Hydrological Decade, *Reviews, Water management (Applied), Water quality, Environmental effects, Environment, Ecology, Planning.
Identifiers: IHD programs.

Civilization's dependence on the world's water resources is discussed. Not only does our civilization depend on water availability, but water resources are profoundly affected by civilization. Water development and water policies always have been important, as is evident from the many physical and administrative measures to control its distribution and use, beginning with the ancient Sumerians of Mesopotamia and becoming ever more complex with the passage of time. Even so, water problems are becoming increasingly critical in many regions, including areas in developed countries where water is relatively abundant. The reason is that in many regions problems are less apt to relate to water quantity than to its quality. Broadly stated, water problems are few but basic: distribution in space (too much or too little); distribution in time (too much in some seasons or years and not enough in others); chemical quality (too highly mineralized; lacking in desirable

minerals; containing deleterious minerals); and pollution. The International Hydrological Decade was established, starting in 1965, to study world water problems. The general purpose of the IHD is to accelerate scientific study of water resources and water regimes in order to improve water conservation, management and use. The bulk of the IHD programme consists of activities by participating States within their own territories, catalyzed, co-ordinated and supplemented by international intergovernmental organizations and scientific associations. The programme covers the entire field of hydrology from collection of standard basic data to advanced basic research. (Knapp-USGS)
W70-03450

ARROGANCE TOWARD THE LANDSCAPE: A PROBLEM IN WATER PLANNING,

Geological Survey, Washington, D.C. Water Resources Div.

Raymond L. Nace.

Bulletin of the Atomic Scientists, Vol 25, No 10, p 11-14, Dec 1969. 4 p, 2 photo.

Descriptors: *Water resources development, *Planning, *Projects, *Surveys, *Reviews, Ecology, Urbanization, Land management, History.
Identifiers: Water development history.

The effects of water resources development on water supplies and the environment are surveyed. Water is much more than just a resource to be manipulated on the basis of water data and engineering works. In a society, demands and values change, so no final solution for water problems will be found at any time, and planning must be a continuing process. Rational planning and decision require a base of pooled knowledge from geologists, hydrologists, ecologists, engineers, economists, sociologists, managers, lawyers, politicians and others. Water and its movement through the hydrological cycle are essential means for maintaining the heat balance in the complex system of the earth and its inhabitants. Water is the prime agent that shapes or misshapes the landscape, according to what kind of landscape it encounters. Men have much to do with the latter. Is it mere coincidence that Persia, Egypt, West Pakistan, India, and China—all 'underdeveloped' areas today—were the seats of the oldest civilizations. Perhaps it is an inherent characteristic of civilization that it wears out its landscapes. Human occupation, at least during the past 2,000 years, has operated chiefly to harm the landscape, not to preserve it. Ability to plan and create monumental projects carries with it the likelihood of making monumental mistakes. Planning must include careful analysis of the possible results of any water development schemes. (Knapp-USGS)
W70-03465

PRESIDENT'S LECTURE: LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET,

Uppsala Univ. (Sweden). Inst. of Limnology.

For primary bibliographic entry see Field 02H.
W70-03509

7. RESOURCES DATA

7A. Network Design

THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN),

G. V. Zheleznyakov.

Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1968. 291 p, 104 fig, 41 tab, 103 ref.

Descriptors: *Water measurement, *Instrumentation, *Hydrometry, Streamflow, Water levels, Velocity, Turbulent flow, Gages, Hydrometers, Current meters, Weirs, Runoff, Discharge (Water), Hydraulics, Flood plains.
Identifiers: *USSR.

Evaluation, Processing and Publication—Group 7C

The theoretical aspects of hydrometry are discussed and the procedures used in carrying out hydrological observations in rivers and river channels are given. Hydromechanical analyses of instruments for measuring current velocities are also given. The discussion includes: open water surface relief and depth of nonuniform flow; velocity distribution in open turbulent flows; bottom velocities of open streamflows; use of hydrometric devices in open streamflow; hydromechanical analysis of current meters; foundation of the procedures for measuring small velocity streamflows; hydrometric weirs; shape parameters of open-streamflow cross sections; hydraulic and hydrometric methods for the determination of discharges in open river channels; interaction between the flood plain and channel streamflows; and hydraulic basis of the dependence of water levels on streamflow discharges. (Gabriel-USGS)
W70-03474

THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM,
Montana State Univ., Bozeman. Water Resources Research Center.

Theodore T. Williams, and Duain Bowles.

Available from the Clearinghouse as PB-189 407, \$3.00 in paper copy, \$0.65 in microfiche. Montana University Joint Water Resources Research Center, Report No 11, Sept 1968. 40 p, 3 tab, 3 fig, 1 ref, 2 append. OWRR Project A-006-MONT.

Descriptors: *Data collections, *Data transmission, *Hydrologic data.

Identifiers: *Collecting hydrologic data, *Acquisition system, *Digital signals, Teletype machines, Electronic instruments.

Three recording rain gages, three recording hygrometerographs and three Parshall flumes equipped with water level recorders were installed on the Maynard Creek watershed. The instruments were modified to permit the simultaneous transmission of data over the Bridger Data Acquisition System to the Montana State University campus. Conclusions are that a Data Acquisition System provides many advantages to a hydrologic researcher, but that certain recommendations should be considered: (1) Avoid 'piggy-back' parallel operation of electronic instruments through modification of conventional instruments. (2) Convert analog to digital signals at the instrument, and transmit only digital signals via telemetry. (3) Avoid long 'ground surface' cabling networks. (4) Review data promptly and regularly to spot any malfunction that may arise.
W70-03615

7B. Data Acquisition**A NEW RECORDING TURBIDITY METER FOR RIVERS,**
Natal Univ., Durban (South Africa).

W. James.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 71-76, Dec 1969. 6 p, 6 fig, 1 ref.

Descriptors: *Turbidity, *Instrumentation, *Sampling, Opacity, Light penetration, Optical properties, Suspended load, Rivers, Water quality. Identifiers: *Natal, Turbidity meters.

An inexpensive continuously recording turbidity transducer on two different types of mounting has been developed at the University of Natal, and installed at two stations in the Umgeni River system. The geometry and components of the transducers are detailed, and a sampler used to calibrate the transducers is also described. A portable turbidity meter has also been developed. (Knapp-USGS)
W70-03277

AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (Netherlands).
For primary bibliographic entry see Field 02J.
W70-03282

X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 02J.
W70-03286

PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING,
Gulf Research and Development Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 02J.
W70-03287

ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY,
Washington State Univ., Pullman. Dept. of Zoology.
Vincent Schultz.

US Atomic Energy Commission, Division of Technical Information, RLO-2213-1, Dec 1969. 252 p, 3081 ref.

Descriptors: *Bibliographies, *Radioecology, *Radioisotopes, *Radioactivity, *Radiation, Aquatic environments, Terrestrial habitats, Analytical techniques, Environmental effects, Tracers, Pesticides.

Identifiers: *Ecological techniques, Data acquisition, Freshwater environments, Marine environments.

Environmental deterioration has increased public awareness of the ecologist's role in predicting and alleviating the effects of cultural misuse of the environment. Complexities of the problems, now and in the future, require that ecologists develop and utilize the most advanced techniques possible to elucidate information which can be used for intelligent and effective decisions regarding environmental management. This bibliography of 3081 entries attempts to focus the attention of all ecologists on techniques utilizing radionuclides and ionizing radiation developed by freshwater, marine, and terrestrial ecologists, as well as by scientists in closely related fields. Of all references cited, with publication dates between 1922 and 1969, approximately 87% are dated in the decade beginning 1960. The most recent literature and Russian contributions are well represented in the list. (Eichhorn-Wisconsin)
W70-03308

NONDESTRUCTIVE TESTING,
Machine Design, Cleveland, Ohio.
Francis J. Lavoie.
Mach Des, Vol 41, No 20, p 122-135, Sept 1969. 14 p, 19 fig.

Descriptors: *Non-destructive tests, *Materials testing, *Test procedures, Radiographic inspection, Quality control, Inspection, Materials engineering, X-ray inspection, Gamma rays, Neutrons, Fluoroscopes, Ultrasonics, Thermographs, Penetration, Microwaves, Acoustic equipment, Measuring instruments.

Identifiers: *Testing equipment, Radiography, Ultrasonic tests, Eddy currents, Stress waves, Holography, Acoustic method.

This review of nondestructive test methods ranges from the established and widely known methods to the newest and most glamorous, and includes flaw or defect-finding techniques. The methods described are: radiography, ultrasonics, thermal techniques, penetrants, magnetic inspection, microwaves, eddy current, acoustic emission, and

holography. Radiographic methods include X-ray, gamma ray, neutron, radiation backscatter, fluoroscopy, color radiographs, and xeroradiography. Holography, one of the most glamorous developments in recent years, is well suited for flaw detection. (USBR)
W70-03356

A RAINFALL RATE SENSOR,
Coast and Geodetic Survey, Rockville, Md.
Brian E. Morgan.

ESSA Tech Memo ERLTM-NSSL 42, Nat Severe Storms Lab, Norman, Okla, Nov 1968. 10 p, 7 fig, 2 ref.

Descriptors: *Rainfall, *Rain gages, *Meteorological instruments, *Hydrologic instruments, Rain, Measuring instruments, Instrumentation, Meteorology, Hydrology, Thunderstorms, Meteorological radar, Sensors, Oscillators, Capacitance, Electrodes.
Identifiers: Hydrometeorology.

A rainfall rate measuring instrument that has a range of 250 mm/hr, an accuracy of plus or minus 2 mm/hr, and gives total rainfall within 2% was developed. The gage is inexpensive to build and operate, and does not require daily attention because water does not accumulate. Rainwater passes from a collector into a cylindrical reservoir formed between 2 concentric electrodes. Water empties from the reservoir through a small nozzle at the base. Water depth in the reservoir is related to the inflow or rainfall rate that varies the capacitance between the 2 electrodes. The rainfall rate is measured by an oscillator having the electrodes as capacitance elements that translate depth changes into frequency variations. Equations are developed for relating rainfall rate to frequency, with emphasis on relevance to design of the instrument for specific applications. Laboratory test results and rainfall measurements are discussed. (USBR)
W70-03363

A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology.

Seymour R. Baker, and Gerald M. Friedman.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1371-1383, Dec 1969. 13 p, 18 fig, 4 ref. ONR Contract No N0001467-A-0117-0004.

Descriptors: *X-ray analysis, *Analytical techniques, *Sediments, *Cores, Stratigraphy, Structural geology, Sampling, Instrumentation, Particle size, Carbonates, Photography.
Identifiers: X-ray core analysis technique.

An X-ray technique which permits the identification of sedimentological, stratigraphic, and structural characteristics of core samples is described. This technique utilizes an aluminum filter which compensates for the difference in sediment thickness through which the X-ray penetrates. This quick, easy, and inexpensive method provides a complete picture log of the core. (Gabriel-USGS)
W70-03470

7C. Evaluation, Processing and Publication

THE WATER RESOURCES SITUATION IN PUERTO RICO: AN EVALUATION OF PUBLISHED INFORMATION,
Puerto Rico Univ., Mayaguez. School of Engineering.
For primary bibliographic entry see Field 06B.
W70-03245

COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY,
Colorado State Univ., Fort Collins.

Field 07—RESOURCES DATA

Group 7C—Evaluation, Processing and Publication

Ignacio Rodriguez-Iturbe, and M. M. Siddiqui.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 77-94, Dec 1969.
18 p, 5 fig, 18 ref.

Descriptors: *Statistical methods, *Frequency analysis, *Time series analysis, Stochastic processes, Uniformity coefficient, Regression analysis, Probability, Hydrology, Rainfall-runoff relationships, Streamflow forecasting.

Identifiers: Spectral analysis, Coherence analysis, Cross-spectral analysis.

Cross-spectral characteristics of the moving average and autoregressive processes are shown to be a powerful tool in testing and analyzing processes in hydrology. The coherence between two 1st order autoregressive processes is shown to be equal to a constant, independent of frequency. (Knapp-USGS)

W70-03256

REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA,

Pittsburgh Univ., Pa. Dept. of Civil Engineering.
Rafael G. Quimpo.

Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 111-118, Dec 1969. 8 p, 1 fig, 10 ref.

Descriptors: *Statistical methods, *Data processing, *Hydrologic data, *Streamflow, *Correlation analysis, Sampling, Parametric hydrology, Data collections, Water supply, Regression analysis, Storage, Digital computers.

Identifiers: Serial correlation.

The need for specifying water availability in terms of its time sequence and distribution, rather than in terms of lumped quantities or flow duration, gives rise to data acquisition programs which use shorter sampling intervals. Shorter time intervals, in turn, resulted in serially correlated observations. In order to determine the reliability of design variables derived from these observations, it is necessary to reduce data to an equivalent series of independent observations, or find the effective length of the series. A general parametric formula is developed to give the effective number of observations of the second order autoregressive process, which was found to apply to series of mean daily river flows. Different values of the parameters were programmed in a digital computer to obtain tables for data reduction. (Knapp-USGS)

W70-03263

THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,

Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.

W70-03296

SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA,

Shell Oil Co., Denver, Colo. Rocky Mountain Div.; and Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering.

For primary bibliographic entry see Field 02F.

W70-03297

VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS,

Waterloo Univ. (Ontario).
B. P. Sangal, T. E. Unny, and H. M. Hill.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ., Fort Collins. Vol 1, Paper 41, p 314-321, 1967. 8 p, 2 fig, 4 tab.

Descriptors: *Streamflow forecasting, *Statistical methods, Climatology, Regression analysis, Data processing, Digital computers, Computer programs, Hydrologic data.

Identifiers: Streamflow record length.

Hydrologic data are necessary in the planning and development of a water resource project. More and better data result in better project decisions. Unfortunately, often important decisions have to be made in spite of hydrologic deficiencies. This paper describes a statistical analysis of long (48 years) flow records of five streams in Southern Ontario (Canada). The computations are carried out at the University of Waterloo IBM 7040 computer. Records of 20-25 years are considered adequate for the estimation of mean annual runoff. The results are considered acceptable within 10-15 percent of their long-term values. (Knapp-USGS)

W70-03303

BUILDING A COMPUTER-BASED MIS,

Terminal and Display Systems, Inc.
For primary bibliographic entry see Field 10.

W70-03360

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS,

Geological Survey, Washington, D.C. Office of Water Data Coordination.

K. F. Harris, J. R. Rapp, and E. B. Chase.

Available at no cost from Office of Water Data Coordination, US Geol Survey, Wash, DC, 20242. Geological Survey Water Data Catalog, 1969. 391 p, 2 fig, 2 exhibit, 4 tab.

Descriptors: *Data collections, *Hydrologic data, *Water quality, *Documentation, *Data storage and retrieval, Networks, Monitoring, Sampling, Maps, Instrumentation, Stations, Libraries, Investigations.

Identifiers: *Catalog of Information on Water Data.

An index is presented for use in retrieving water quality data from the Catalog of Information on Water Data, a record of activities in water data collection in the U. S. The Catalog is a file of information that is accessible through data-retrieval procedures—it contains information about water-data acquisition activities but does not contain the actual data, which must be obtained from the reporting agencies. Input to the Catalog consists of information supplied by Federal, State, and local agencies that acquire water data directly in the field and laboratory. All information is stored on media suitable for data processing, supplemented by microforms and maps. Information from the Catalog (output) is made available through indexes such as this publication, which is the index to the water quality section of the Catalog. The indexes help the water-data user determine the data that are available for an area and also the data available from a reporting agency. The index includes the title of each investigation reported, the geographic area covered, a description of types of data collected, whether or not a report will be published, and the reporting agency. (Knapp-USGS)

W70-03473

CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS,

Coast and Geodetic Survey, Rockville, Md.
For primary bibliographic entry see Field 02L.

W70-03476

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,

State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).

For primary bibliographic entry see Field 02A.

W70-03496

THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM,

Montana State Univ., Bozeman. Water Resources Research Center.

For primary bibliographic entry see Field 07A.
W70-03615

08. ENGINEERING WORKS

8B. Hydraulics

UNIVERSAL FORMULA FOR UNIFORM FLOW,

Tennessee Valley Authority, Norris. Engineering Lab.

Walter O. Wunderlich.

Civil Engineering - ASCE, Vol 40, No 1, p 51-52, Jan 1970. 2 p, 8 ref.

Descriptors: *Open channel flow, *Equations, Chezy equation, Manning's equation, Reynolds number, Roughness (Hydraulic), Turbulent flow, Steady flow, Uniform flow, Mathematical studies.
Identifiers: Blasius equation.

Formulas for computing uniform open channel flow are briefly reviewed. The discussion includes Chezy's formula, modified Chezy's formula, Manning's formula, Blasius' formula, and formulas for turbulent flow along rough walls. (Knapp-USGS)
W70-03248

THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN),

For primary bibliographic entry see Field 07A.
W70-03474

STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR,

Oregon State Univ., Corvallis.

E. Harvey Elwin, and Larry S. Slotta.

ASCE National Water Resources Engineering Meeting, Jan 26-30, 1970. Preprint, 38 p, 30 ref, 17 fig.

Descriptors: *Model studies, *Stratification, *Quality control, *Density currents, Streamflow.

This study relates various parameters of entering streamflow at the upper end of a stratified reservoir to the current regime in the reservoir for the purpose of maintaining quality control. The model reservoir for the inflow experiments was a clear walled, rectangular, plexiglas flume. It was equipped with an adjustable bottom slope and a connecting streamlined slope. The reservoir was 25 feet long, 18 inches wide, and 22 inches deep. Various concentrations of a sodium chloride solution were used to provide a linear density stratification. Flowfield current patterns and velocity measurements were determined photographically. Flow parameters relating the existence, location and magnitude of model internal density currents to entering streamflow characteristics were found. The applicability of these model reservoir results to prototype reservoir conditions is discussed. Some conclusions were: (a) For the range of values tested the entering model streamflow created two possible main inflow density currents in the model reservoir. (b) The upper inflow current increased its magnitude as the model streamflow Reynolds number increased. (c) The elevation of the upper inflow current was independent of the velocity and density of the inflow. The evaluation of the lower inflow current was dependent on the density of the inflow and the mixing which occurred at the stream mouth. (d) The interaction between two reservoir density currents created a significant reinforcement of both currents. (Guerrero-Vanderbilt)
W70-03543

MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Joseph R. Bohan, and John L. Grace.

ASCE National Water Resources Engineering Meeting, Memphis, Tenn, Jan 26-30, 1970. Preprint, 33 p, 22 ref, 12 fig.

Descriptors: *Stratified flow, *Orifices, *Model studies.

Identifiers: *Velocity distribution, *Water intakes.

The purpose was to determine the characteristics of the withdrawal zone upstream of an orifice for various conditions of stratification in order to develop generalized equations for use in predicting the quality of water discharged through similar openings in prototype intake structures. The experimental facilities contained an orifice cut in a piece of plastic and located in the center of a 1-ft. wide channel. Approximately 18 ft. of the 1-ft. wide, 2-ft. deep channel was provided upstream of the orifice and a headbay 40 feet long, 16 feet wide, and 4 feet deep was provided upstream of the channel. Stratification was generated using dissolved solids (salt). Temperature and salinity gradients were measured in place by means of commercially available instrumentation. All the tests were conducted with steady uniform flow conditions. Some conclusions were: (a) A means of predicting the limits of and the velocity distribution within the zone of withdrawal upstream of an orifice has been developed. (b) Three dimensional models operated in such a manner that they reproduce typical hydrograph records should be utilized to investigate the effects of unsteady and varied flow conditions due to variations in geometry, inflow, outflows, storage and density. (c) Additional studies are desired to investigate model scale effects and the relative importance of viscous effects. (d) The effect of geometry in the vicinity of an intake structure has been observed to be significant based on the results of specific model studies. (Guerrero-Vanderbilt)

W70-03544

ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS,

Waterloopkundig Laboratorium, Delft (Netherlands).

G. Abraham.

Journal of Hydraulic Research, Vol 3, No 2, p 1-23, 1965. 6 fig, 1 tab, 18 ref.

Descriptors: *Jets, *Buoyancy, *Turbulent flow.

Identifiers: *Entrainment.

Studies were made of the theories for solution of jet problems based on both the entrainment principle and the similarity of velocity and concentration profiles. Jets with negligible and with predominant influence of buoyancy effects are described. The implications of the contradictory starting points which are based on both the entrainment principle and the similarity of velocity and concentration profiles are explained, and a new coefficient is introduced. This parameter, E' , is a dimensionless representation for the rate at which work is done by turbulent shear. Conclusions were: (a) the similarity of velocity and concentration profiles is shown to imply that the entrainment coefficient alpha is a variable quantity. Accordingly, theoretical solutions based on both the similarity of velocity and concentration profiles and on the entrainment principle, which implies alpha to be constant, are based on contradictory starting points, (b) theoretical solutions based on the assumption of alpha being constant may give incorrect values of the ratio of the radius of the jet to the distance from the orifice, (c) the similarity of velocity and concentration profiles was shown to be compatible with the assumption of the parameter E' being constant. (Guerrero-Vanderbilt)

W70-03545

DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING,

California Inst. of Tech., Pasadena, Calif. W. M. Keck Lab. of Hydraulics and Water Resources.

Loh-Nien Fan, and Norman H. Brooks.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 92, No SA1, p 296-300, Feb 1966.

Descriptors: *Mixing, *Stratification, Froude number.

Identifiers: *Buoyant plume, Model.

Research performed by Frankel and Cumming provided greater insight into the problem of mixing of a buoyant plume in a homogeneous environment such as jet discharges of sewage effluent from ports in an ocean outfall diffuser, when the ocean is not density-stratified. The effect of the free surface is discussed, and it is concluded that the wide discrepancy between Frankel and Abraham's theory is not explained by the effect of the surface zone and that the thickness of the transition zone should be considered not only as a simple proportion of the depth but also as a function of the parameters of the rising plume, depth-diameter ratio, Froude number and the discharge angle. Furthermore, the thickness should also be related to the character of the horizontal surface flow layer as well as the rising plume. In performing experiments in the laboratory, it was found more convenient to inject salt solutions into fresh water and observe the pattern of the falling plume. In the discussion of the asymptotic rate of change of measured concentration with depth, a contradiction was found to the author's conclusion that for large depth-diameter ratio, the exponent in the equation approaches one. The conclusion that 'further increases in depth beyond depth-diameter ratio equal 50 give minimal advantages to mixing in the vicinity of the discharge point', is disputed and an example is given. (Guerrero-Vanderbilt)

W70-03553

JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY,

Chalmers Univ. of Technology, Goteborg (Sweden). Hydraulics Div.

Klas Cederwall.

Chalmers Institute of Technology, Goteborg, Sweden, Feb 1967. 28 p, 17 ref.

Descriptors: *Jets, *Diffusion, *Testing, *Model studies, *Outlets, *Sewers.

The significance of laboratory investigations in solving various jet diffusion phenomena is discussed. Pertinent parameters such as the density and composition of the disposed effluent, hydraulic characteristics of sewage discharge, and oceanographic features of the disposal site area and boundary conditions are analyzed. The possibilities of reproducing field data in model tests, model laws on jet diffusion, tracer technique, sampling and recording devices are discussed. The study on jet diffusion in stagnant receiving water carried out by Abraham serves as a basis for discussion of the experimental studies on jet diffusion and a comparison with theory in the cases of vertical jet diffusion, horizontal jet diffusion and high velocity release. In most cases, a fair agreement was found between the analytical procedure and experimental data. (Guerrero-Vanderbilt)

W70-03555

DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY' BY G. ABRAHAM,

California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.

Loh-Nien Fan, and Norman H. Brooks.

Journal of the Hydraulics Division, Proceeding ASCE, Vol 92, HY2, p 423-429, Mar 1966.

Descriptors: *Jets, *Stratification, Turbulent flow.

Identifiers: *Entrainment rate.

Abraham's representation of the entrainment rate in the jet is discussed, and it is mentioned that one of the main difficulties in analysis of turbulent jets is to specify the rate at which fluid is entrained in the jet or alternatively to specify the rate of growth of the plume or jet. The writers suggest an alternative to the author's representation of the entrainment rate, assuming that the rate of entrainment is proportional to the local characteristic (or maximum) velocity, u_m , and the local characteristic radius of the jet or plume, following the techniques used by Morton, Taylor, and Turner, and Morton. By this means, full use is made of the continuity equation. An analysis of how the problem solved by

Abraham can also be readily solved using the continuity equation with constant entrainment coefficient is made. The results agree with Abraham's and thus suggest that the simple entrainment formula is as valid as the author's approach, with the advantage that is more flexible and can be used on a wider variety of problems, such as those involving buoyant jets and plumes in a stratified environment. (Guerrero-Vanderbilt)

W70-03560

STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE,

Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.

Venkata Subramanya Shastri Annambhotla. Ph. D. Thesis, University of Iowa, Aug 1969. 137 p, 9 tab, 27 fig, 50 ref. OWRR Project A-015-IA (5).

Descriptors: *Alluvial channels, Channel morphology, *Roughness (Hydraulic), *River beds, *Flow resistance, Fluid friction, Flumes, Hydraulic design.

Identifiers: *Bed forms (River), Hydraulic friction factor.

The statistical properties of dune bed forms in alluvial channels was investigated and related to the hydraulic friction factor. Emphasis was placed on the relationship between resistance to flow and bed configuration in large rivers. Bed profile records were acquired from a straight 3-foot wide laboratory flume and from the Missouri River at Omaha, Nebraska. Discrete digital data of the fine sand bed profiles were obtained from continuous records and statistical computations were performed. The river data were nonstationary both in the mean and in the mean square. A filter was selected to render the data stationary in the mean. Pilot studies, made by analyzing selected river data by spectral analysis and zero-crossing distances and amplitudes analysis, suggested that the latter of the two methods is preferable. Statistical properties of the wave lengths, amplitudes and heights were evaluated by the zero-crossing distances and amplitudes analysis for selected flume data and all river data. A study of the frequency distributions of the bed form characteristics showed that the bed elevations were approximately normally distributed and that the wave lengths, amplitudes and heights were approximately exponentially distributed. The bed form friction factor was plotted against a modified relative roughness parameter defined in terms of the bed form dimensions and the hydraulic mean radius of the flow. A more definitive resistance relationship could not be formulated, however, because of the limited number of observations and also because of inadequate information on the suspected effects of the variations in the shape and arrangement of dune forms. Effects of water temperature on bed form roughness were observed to be significant. The tendency in the Missouri River was that the bed forms became rougher with increasing temperatures and vice versa. Reasonably good measures of bed form characteristics can be obtained by statistical analyses.

W70-03620

8C. Hydraulic Machinery

FLOW BETWEEN A RESERVOIR AND A HEADPOND,

Spiridon Iliev.

Water Power, Vol 21, No 9, p 331-335, Sept 1969. 5 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Electric power production, *Forebays, Hydraulic engineering, Piping systems (Mechanical), Hydraulic properties, Pressure tunnels, Hydraulic design, Equations, Hydraulics, Continuity equation, Pressure pipes, Foreign research, Hydroelectric plants, Reservoirs, Hydroelectric power.

Identifiers: Design assumptions, Comparative studies, Bernoulli theorem, USSR.

Field 08—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

Some costs of a hydroelectric system involving a reservoir remote from the power station may be saved by constructing a headpond near the station, thereby reducing the required diameter of the supply tunnel or pipeline. Using a headpond permits a reduction in installed capacity of the power plant and makes possible a larger output because the local storage can be used with smaller losses and the limiting condition for critical velocity in the connecting supply tunnel or pipeline can be avoided. Equations are derived for solving the hydraulics of a supply system containing a headpond; a sample problem is presented. (USBR)

W70-03355

ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND FUTURE DEVELOPMENT OF GRAND COULEE DAM, Bureau of Reclamation, Boise, Idaho.

G. R. Barker.

Pap, 83rd Annu Gen Meet Eng Inst Can, Vancouver, Sept 1969. 13 p.

Descriptors: *Grand Coulee Dam, *Electric power production, *Peak power, Project planning, Irrigation, History, Multiple-purpose projects, Electric power, Investigations, Peaking capacities, Automation, Energy, Pumping plants, Pump turbines, Stators, Flood control, Hydroelectric plants, Columbia River, Hydroelectric power.

Identifiers: Grand Coulee Powerplant (Wash), Grand Coulee Pumping Plt (Wash), Pacific Northwest-Southwest Intertie, Base loads.

Factors affecting the development of Grand Coulee Dam from inception as a key structure for an irrigation project, through present-day multi-purpose operation, and into the future on a coordinated power peaking and irrigation pumping schedule are described. The history of the Grand Coulee Dam from 1918, with Rufus Wood's first published story of a proposed high dam on the Columbia River to the present-day 1974 mw of generating capacity and 6 pumping units capable of irrigating 600,000 acres of land, is reviewed. A program of rewinding existing 108-mw generators to produce 125 mw is scheduled for completion by 1977. Modernization features being initiated for automating the plant are discussed. Future installations call for a Third Powerplant of 12 units, 600 mw each, and 6 additional pump-turbine units in the pumping plant, bringing the ultimate capacity of the Grand Coulee Dam to 9771 mw, the largest single electric power generating station in the world. (USBR)

W70-03358

THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION, N. I. Pylaev, and A. A. Sotnikov.

Energomashinostr, Vol 14, No 2, p 26-28, 1968. Transl from Russ, Bur Reclam Transl 823, Oct 1969. 9 p, 5 fig, 3 ref.

Descriptors: *Cathodic protection, *Hydraulic turbines, *Cavitation, Laboratory tests, Electric fields, Corrosion, Anodes, Corrosion control, Cathodes, Foreign research, Electric potential, Conductivity, Protective coatings, Electrodes.

Identifiers: USSR, Current density, Test results, Cavitation control.

The electrochemical method of protection from cavitation erosion has been applied experimentally on turbines of a few hydroelectric powerplants. The method consists of the simultaneous use of protective zinc paint and cathodic protection from an external source. Under turbine operating conditions, evaluating the effectiveness of electrochemical protection is difficult. Laboratory experiments were conducted to study the effectiveness of cathodic protection; results are reported. From a study of the electric field in a model turbine, calculations were made of the cathodic protection parameters for the Krasnoiarst turbines, indicating that no less than 400 v would be required. Such voltage cannot be considered permissible from a safety engineering standpoint. Efficient cathodic

protection on large hydraulic turbines operating in water with high specific resistance becomes practically impossible. (USBR)

W70-03366

ASSESSING OUTDOOR INSULATION, Centro Elettrotecnico Sperimentale Italiano, Milan.

P. Bernadelli.

Energy Int, Vol 6, No 8, p 20-24, Aug 1969. 5 p, 4 fig, 2 tab, 16 ref.

Descriptors: *Contamination, *Electrical insulators, Atmospheric pollution, *Electric insulation, *Laboratory tests, Test procedures, Lightning, Dusts, Salts, Foreign research, Test facilities, Air pollution, Air pollution effects, Bibliographies.

Identifiers: *Contaminants, *Leakage current, *Flashover, Italy, Switching surges, Lightning surges, Reproducibility, Electric discharges.

The problem of external electric insulation in contaminated areas is becoming increasingly important because of growing industrialization in continental areas and the location along sea coasts of large thermal powerplants with their associated substations and high voltage lines. In such particularly contaminated areas, pollution produces an insulation stress almost as important as that caused by lightning and switching overvoltages. Two laboratory testing methods, the salt fog method developed in England and the dust deposit method developed in Germany, are discussed and a cost comparison between the 2 types of installations is given. A general review of the present state of investigations on the behavior of external electrical insulation in contaminated atmosphere is given, with particular reference to a-c voltage stress. Available knowledge permits an engineering approach to insulation design problems. After sufficient experience, some laboratory testing method should become standarized by international bodies. (USBR)

W70-03368

EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT, M. L. Steklov.

Energomashinostr, No 5, p 6-10, 1969. Transl from Russ, Bur Reclam Transl 822, Oct 1969. 16 p, 3 fig, 5 ref, append.

Descriptors: *Hydraulic machinery, Kaplan turbines, Turbine runners, *Hydraulic turbines, Stay rings, Stay vanes, *Turbine parts, *Bearings, Draft tubes, *Bulb turbines, Prototype tests, Field tests, Generators, Oil reservoirs, Bearing capacities, Hydraulic design, Water cooling, Foreign research, Servomechanisms.

Identifiers: USSR, Experimental design, Saratov Powerplant (USSR), *Pressure control mechanism.

Two experimental Kaplan bulb turbines having the same dimensions but slightly different design will be installed at Saratov Hydropowerplant for field testing. The main difference in design is the method of supporting the units: The first has 2 bearings and inlet and outlet stay rings; the second, without the outlet ring, has an extra turbine bearing and cantilever support of the runner. Advantages of the second design are improved power characteristics and a reduction of more than 10% in weight, but the satisfactory support of the turbine without the outlet stay ring under all operating conditions must be demonstrated. All preliminary bearing tests indicate that the bearings with 2 fixed upper shoes and 8 self-leveling lower shoes will take double the normal operating load, but the Soviet turbine designers feel that this side-by-side prototype testing is necessary because of the increased size of these units in physical dimensions and capacity as compared to any operating units of the world. A new design of combined oil and water head in the bulb nose, reducing the overall space of this equipment, supplies the oil to the servomotors from the electrohydraulic governor system and the water to cool the generator rotor. (USBR)

W70-03369

HYDRAULIC CONTROLS OF WATER LEVEL, E. E. Makovskii.

Gidrotekh i Melior, No 8, p 35-42, 1968. Transl from Russ, Bur Reclam Transl 688, Aug 1969. 18 p, 8 fig, 3 ref.

Descriptors: *Irrigation canals, Irrigation practices, Hydrodynamics, Irrigation systems, Automation, *Automatic control, Check structures, Foreign design practices, Irrigation operation and maintenance, Water measurement, Water surface profiles, Turnout gates, Remote control, Gates, Instrumentation, Mechanical equipment, *Water levels.

Identifiers: USSR, Water distribution.

Automatic remote control of water levels in all checks and drops in an irrigation system (cascade controls) has been developed and tested successfully in the USSR in the Atbasinsk Main Canal in Kirgiz SSR since 1963. Standard designs for cascade controls with downstream protection against overfilling are being perfected and tested for general use in the Northern Crimean Canal in the Ukraine. The mechanics and operating principles of several alternative designs of cascade control systems are investigated. Mathematics for designing such systems and graphs for determining the various gate parameters, such as vertical contraction of flow and depth of submergence, are given. This system of hydraulic controls probably gives more reliable and flexible water-level control with settings within wider limits than well-known foreign designs, especially where there are floating materials in the canal or significant drops in water level or rapid flow downstream. (USBR)

W70-03373

MHD POWER GENERATION: CURRENT STATUS,

Tennessee Univ., Tullahoma. Space Inst.; and Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.

J. B. Dicks, Stewart Way, and T. R. Brogan. Mech Eng, Vol 91, No 8, p 18-25, Aug 1969. 8 p, 7 fig, 53 ref.

Descriptors: *Magnetohydrodynamics, Electric power, *Electric power production, *Magnetic fields, *Gases, Reviews, Experimental data, Ions, Bibliographies, Electrodes, Electric fields, Seeding, Efficiencies, Research and development, Economics, Excitation, High pressure.

Identifiers: Gas conductors, Fossil fuels, High temperature, Superconductors.

In magnetohydrodynamic (MHD) generation, a gas moves through a magnetic field to produce an electric current. The internal energy of the gas stream is converted directly to electric energy that is drawn off through electrodes replacing the brushes of conventional generators. The status of MHD generation is discussed and experimental MHD units ranging from 3 to 32 mw are reviewed. Three approaches to MHD power are explored, the open-cycle system, the closed-cycle system, and the liquid metal system. Of these 3 types, the open-cycle system is closest to practical realization. This report concentrates principally on the attainments, problems, and outlook for open-cycle MHD powerplants for commercial applications. (USBR)

W70-03374

MULTIPLE USE OF RIGHTS OF WAY: A CHALLENGE TO THE PAST, Federal Power Commission, Washington, D.C.

Carl E. Bagge.

Pap, Conf Joint Util Rights Way, Deerfield, Mass, July 1969. 14 p.

Descriptors: *Right-of-way, Environment, Aesthetics, Project planning, *Multiple use, Planning, *Public utilities, Public relations, Ecology, *Public services, Legislation, Legal aspects, *Utilities, *Future planning (Projected).

Identifiers: *Land acquisition, Electric utilities, Regional planning, Regional authorities.

Joint rights of way for highways, energy transmission, and communications at appropriate distances from each other should be considered simultaneously with the development of comprehensive regional plans. The central theme of effective regional planning is the early acquisition of land for such public service rights of way. This is a matter of urgency in congested areas and a means of preventing serious problems in less populated areas. The form of acquisition could be determined easily once the philosophical commitment is made. Many public service companies share rights of way, and recently joint use has been emphasized by government, industry, and citizens groups as a promising means of minimizing the intrusion of utility rights of way on the quality of our environment. Examples are cited of low-voltage powerlines and telecommunications lines sharing rights of way with each other, as well as with railroads and pipelines. The coordinated efforts of the President's Council on Environmental Quality, the Citizens Advisory Committee on Environmental Quality, and the affected public service industries should provide the most effective level for meeting the challenges of multiple use. (USBR)

W70-03376

WATER SUPPLY TO THERMAL POWER PLANTS,

Sargent and Lundy, Chicago, Ill.

For primary bibliographic entry see Field 03E.

W70-03548

8D. Soil Mechanics

CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.

Federal Water Pollution Control Administration, Edison, N.J. Northeast Region Research and Development Program.

For primary bibliographic entry see Field 05C.

W70-03349

THE PRINCIPLE OF REINFORCED EARTH,

Bureau d'Etudes de la Terre Armee, Paris (France).

Henri Vidal.

Highw Res Rec, No 282, p 1-16, 1969. 16 p, 37 fig.

Descriptors: *Reinforcing, *Reinforcement, *Earth, *Earthworks, Foreign design practices, Retaining walls, Theory, Calculations, Economics, Soil mechanics, Soil Engineering, Comparative costs, Comparative benefits, Friction, Tensile stress, Strength, Structures, Stress, Soil strength.

Identifiers: Reinforcing materials, France, Comparative studies, Compressive stress, Flexible structures.

Reinforced earth structures have no height limit, are flexible, simple, and economical to build, and can be designed to support any external forces exerted upon them. Reinforced earth structures are composed of earth, reinforcing disposed in horizontal layers, and a flexible skin facing for retaining the earth particles not in contact with reinforcing strips. Reinforcing elements can be any material possessing the necessary tensile strength and can be any shape giving the necessary friction surface in the required direction. Limitations on earth materials vary with the type of reinforcement used, the general condition being that sufficient friction exists between earth and reinforcement to generate the necessary tensile stresses in the reinforcement. For the conventional type of reinforcement, this condition is met by earth having a friction angle of about 25 deg. The first reinforced earth structures were built in 1964 and have been used for retaining walls, beams, foundation mats, and piers. Many other structures having varying

shapes and sizes could be built. Walls to support highways or railways in urban areas, dams, cofferdams, and tunnels in embankments have been proposed or tested and design calculations developed. (USBR)

W70-03359

VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST,

Bureau of Reclamation, Denver, Colo.

George C. Rouse, and Louis H. Roehm.

Bur Reclam Rep No DD-9, July 1969. 30 p, 12 fig, 1 tab, 16 ref.

Descriptors: *Earth dams, Structural behavior, *Nuclear explosions, Instrumentation, Earth movements, Frequency, Earthquakes, Resonance, *Vibrations, Bibliographies, Seismic investigations, *Shock waves, *Earthquake engineering, Seismic waves, *Underground explosions, Seismic studies, Damping.

Identifiers: Gasbuggy Project, Navajo Dam (N Mex), Seismic stability, Dam stability, Seismic velocity, Seismic tests, Dynamic response.

In Dec 1967, the Gasbuggy subsurface nuclear blast was detonated about 24 mi southeast of Navajo Dam, a 400-ft-high Bureau of Reclamation rolled-earth structure in New Mexico. The blast generated measurable seismic vibrations at the dam. In accordance with a Reclamation request, the Coast and Geodetic Survey investigated the response of the dam to these vibrations by recording horizontal and vertical velocities for 3 points on the structure. Measured data obtained for the crest and a point on the downstream slope are compared to computed data for the same locations. (USBR)

W70-03370

HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING,

Agricultural Research Service, Beltsville, Md. Hydrograph Lab.

For primary bibliographic entry see Field 02G.

W70-03493

8E. Rock Mechanics and

Geology

PRESTRESSING OF THE LINING OF A HYDROTECHNIC TUNNEL IN A WATER-TIGHT ROCK MASS BY GROUTING,

D. Krismanovic, Z. Langof, and H. Zupcevic.

Rock Mech, Vol 1, No 1, p 71-86, July 1969. 16 p, 9 fig, 1 tab, 6 ref.

Descriptors: Tunnel design, *Tunnel linings, Tunnel pressures, Water tunnels (Conveyance), Tunnels, Pressure conduits, *Pressure tunnels, Hydrostatic pressure, Deformation, *Prestressing, Tensile stress, *Grouting, Foreign design practices, Stress, Water tunnels (Testing), Rock mechanics.

Identifiers: Pressure chamber test, Grout mixes, Yugoslavia, Rama Hydroelec Proj (Yugoslavia), Concrete linings.

The use of grouting to prestress a pressure tunnel lining in a watertight rock mass was investigated with a full-scale test. A 5.0-m-dia by 33-m-long test chamber was set up in a special gallery parallel to the tunnel. The reinforced concrete lining was 50 cm thick. Grouting was applied by a group system grouting 32 boreholes simultaneously. Deformations and stresses in the tunnel lining were measured before, during, and within 2 mo after grouting. The chamber was loaded by internal hydrostatic pressure increased gradually over 11 cycles to a maximum of 13.0 atm. Test results show that prestressing can be achieved satisfactorily by grouting. Tensile stresses developed in the lining at total loadings were very low because of prestressing. (USBR)

W70-03367

CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS,

Illinois Univ., Urbana. Dept. of Geology.

Donald G. Miller, and Adrian F. Richards.

Sedimentology, Vol 12, No 3/4, Special Issue, p 301-316, June 1969. 16 p, 4 fig, 1 tab, 36 ref. ONR Contract No 3985 (09).

Descriptors: *Consolidation, *Sediments, *Soil strength, Soil physical properties, Shear, Compressive strength, Cores, Diagenesis, Engineering geology, Carbonate rocks, Particle size.

Identifiers: *Calcareous sediments, *Bahamas.

A comparison is made between the void ratio and pressure relationships resulting from a laboratory consolidation test and a sedimentation-compression computation on a short core of calcareous mud or ooze of low plasticity. Geotechnical measurements of grain size, bulk density, Atterberg limits, water content, vane shear strength, pore-water salinity and carbonate content are graphically related to depth in the core. Results of the laboratory consolidation test on this material differ markedly from the in-place relationship between void ratio, or water content, and the effective overburden pressure, or burial depth, shown by the sedimentation-compression curve. The previous maximum consolidation pressure, based on laboratory consolidation test data, is about 60 times greater than the computed in-place effective overburden pressure. An explanation for this difference would include the different magnitudes of time available for consolidation, cementation occurring in-place, and orientation of the constituents. It is suggested that results of the consolidation test on carbonate muds or oozes should be interpreted with caution for geological and engineering purposes. (Knapp-USGS)

W70-03448

8F. Concrete

RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT,

E. G. Dmitrieva.

Gidrotekh Stroit, No 4, p 22-23, 1966. Transl from Russ, Bur Reclam Transl 706, Sept 1969. 10 p, 2 fig, 3 ref.

Descriptors: Foreign projects, Precast concrete, Reinforced concrete, Concrete technology, Hydraulic structures, *Joints, Foreign research, *Joint fillers, Methodology, Bonding, Concrete mixes, Concrete placing, Concrete testing, Density, *Field control, Field tests, Watertight, *Quality control, Strength, Vibrators (Mechanical).

Identifiers: USSR, Bond strength, Saratov Powerplant (USSR), Vibratory compaction, Construction methods.

The Saratov combined dam and powerplant on the Volga was built from an experimental design, using precast, reinforced concrete elements. The separate elements are joined by placing and vibrating concrete mix in 60-cm-wide joints. Field tests on these joints showed that, with proper technology and equipment, the bond between the concretes of the element and the joint and the density, strength, and watertightness of joint concrete were satisfactory. However, there were many unsatisfactory joints caused by failure to place all concrete in the joint continuously, failure to meet mix specifications, and poor vibration. The recommended technology, when followed, produced the desired results in vertical joints. Additional grouting was necessary for horizontal joints between the monolithic foundation and elements. Adherence to recommended technology must be required, including composition and transportation of mix, placement rate of 8 to 10 cu m/hr, compaction by specified vibrators, maintaining a 16-cm minimum horizontal joint between elements and foundation slab, and pressurization of mix between components supported by special posts. (USBR)

Field 08—ENGINEERING WORKS

Group 8F—Concrete

W70-03371

CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS,

S. S. Davydov.

Beton i zhelezobeton, Vol 15, No 5, p 1-3, 1969. Transl from Russ, Bur Reclam Transl 606, Sept 1969. 9 p.

Descriptors: *Concrete technology, *Polymers, *Plastics, Admixtures, Reinforced concrete, Reinforcing, Chemical stability, Aggregates, Hardening, Physical properties, Mechanical properties, *Materials engineering, *Building materials, Cements, Foreign research.

Identifiers: *Concrete-polymer materials, Concrete products, USSR, *Polymer concretes, Epoxy concretes, Plastic coatings.

Soviet institutes involved in advancing structural sciences have developed plastic cements and concretes capable of overcoming the limitations of conventional concretes. For more diversified and larger structures, modern construction requires materials that are strong, flexible, impact- and abrasion-resistant, chemically stable, and unsusceptible to cracking or surface deterioration. By changing the composition and quantity of components, plastic-concretes can be designed to meet specific needs. Soviet research has studied many plastic additives and admixtures for binders and concretes, as well as polymer coatings, laminated structures, and synthetic glues. Polymer concretes from furfural acetate monomers, hardened by benzenesulfonic acid, were studied extensively and are now being used for underground, mining, municipal, industrial, and transport construction. Problems that need resolving to reduce variations in results and costs, and research conducted in this direction are discussed. (USBR)

W70-03372

8G. Materials

DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS,

Purdue Univ., Lafayette, Ind.

Grant Wernimont.

Mater Res Stand, Vol 9, No 9, p 8-20, 64 and 66, Sept 1969. 15 p, 11 fig, 7 tab, 40 ref.

Descriptors: *Materials testing, *Specifications, *Measurement, *Testing, *Statistical methods, Materials engineering, Variability, Quality control, Tolerances (Mechanics), Test procedures, Test specimens, Sampling, Experimental data, Statistical analysis, Statistics, Bibliographies, Control.

Identifiers: *Test results, Experimental design, Experimentation, Statistical quality control, Accuracy.

Specification testing and statistic design of testing experiments were studied by ASTM Committee E-11 on Statistical Methods. Concepts are presented on the ability of a testing process to discriminate materials that conform to specified tolerances from those that do not. Materials sampling and testing operations are discussed. Considerations involved in the design of testing experiments are given for control within a laboratory and among different laboratories. Strategies are suggested for designing, executing, and interpreting experiments to study the variability of materials, to find and control the variations in test results within and among laboratories, and to estimate components of variance for the material being tested. ASTM Committee E-11 believes that statistical design of experiments is important in preparing standards for materials and test procedures but is subordinate to the technology and art of making measurements. The committee, concerned with the general problem of applying statistical methodology, serves as a consultant to other ASTM committees on specific problems. (USBR)

W70-03354

POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND,

Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.; and Kaiser Aluminum and Chemical Corp., Spokane, Wash.

D. A. Jones, and T. A. Lowe.

J Mater, Vol 4, No 3, p 600-617, Sept 1969. 18 p, 9 fig, 1 tab, 18 ref.

Descriptors: *Corrosion, *Corrosion control, *Polarization, Aluminum, Testing, Electrochemistry, Steel, Experimental data, Field tests, Test procedures, Measuring instruments, Bridges (Electric), Bibliographies, Polarographic analysis, Electrical resistivity, Metals.

Identifiers: *Underground corrosion, Corrosion environments, Corrosion current, *Corrosion tests, Buried metalwork, Comparative studies.

Corrosion of buried metal equipment cannot be measured easily without removal for inspection. Even then, weight loss tests may be impractical, and visual inspection gives only a qualitative appraisal of corrosion. Electrochemical polarization methods give a numerical value of corrosion rate and can be conducted remotely, leaving the corroding specimen undisturbed. An investigation was made to compare various polarization methods for measuring the corrosion rate of buried metal. The Schwerdtfeger polarization-break method and the Stern polarization-resistance method were compared on buried aluminum and steel. Polarization resistance data are easier to interpret and should be more reliable for comparing corrosion rates calculated by various investigators. In conducting the polarization experiments, ohmic contributions from measured polarization potentials were removed by using the Holler bridge circuit. Relatively low 100-kilo-ohm resistors in the bridge circuit did not appreciably affect calculated corrosion rates, although the resistors did permit polarization of the reference electrode in the circuit. (USBR)

W70-03365

OIL AND GAS.

Tenn Code Ann sec 60-202 (1956).

Descriptors: *Tennessee, *Wells, *Well casings, *Oil wells, Drilling, Saline water intrusion, Well regulations, Natural gas, Oil, Saline water, Mineral water, Construction materials, Steel, Iron, Fresh water, Groundwater, Legislation, Regulation.

Identifiers: *Gas sand, *Wrought iron.

A well drilled into oil and gas sand for the production of petroleum oil, natural gas, salt water, or mineral water must be encased with wrought iron, steel, or metal casing before drilling in order to exclude all surface water, salt water or fresh water from reaching the oil and gas sand. (Powell-Florida)

W70-03425

8H. Rapid Excavation

NUCLEAR EXCAVATION: REVIEW AND ANALYSIS,

L. J. Circi, Jr.

Eng Geol, Vol 3, p 5-59, 1969. 55 p, 25 fig, 4 tab, 88 ref.

Descriptors: *Craters, *Nuclear explosions, *Underground explosions, Excavation, Rock excavation, Nuclear energy, Reviews, Safety, Canals, Radiation hazards, Harbors, Reservoir construction, Panama Canal, Cuts aggregates, Landslides, Bibliographies, Construction.

Identifiers: *Nuclear excavation, *Plowshare Operation, *Rapid excavation, Construction methods.

Nuclear cratering technology has advanced to such a state that meaningful predictions of crater and channel sizes in selected media can be made with confidence. Continuing research is underway to ex-

tend basic cratering knowledge to saturated, fine-grained, and stratified media. Significant advances have been made in evaluating the magnitude and extent of safety hazards associated with underground nuclear cratering detonations. Many excavation projects for harbors, reservoirs, canals, and aggregate production are feasible. Nuclear excavation provides a method for alleviating potentially catastrophic situations that could result from floods, landslides, and volcanoes. The development of nuclear excavation into a standard engineering tool will be determined by factors not related entirely to technical feasibility. Political and social pressures will weigh heavily in the ultimate acceptance. (USBR)

W70-03362

VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST,

Bureau of Reclamation, Denver, Colo.

For primary bibliographic entry see Field 08D.

W70-03370

MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS,

Geological Survey, Denver, Colo.

M. S. Garber, and L. E. Wollitz.

Groundwater, Vol 7, No 4, p 3-7, July-Aug 1969. 5 p, 10 fig, 6 ref.

Descriptors: *Underground explosions, *Aquifers, Groundwater, Effects, Measurement, Water levels, *Water level fluctuations, Water wells, Water table, Wells, Forecasting, *Nuclear explosions, Aquifer characteristics, Transducers, Instrumentation, Oscilloscopes.

Identifiers: Water-level recorders, Explosive construction, Packings, Plowshare Operation, Pressure transducers.

Underground detonations may produce observable effects in surrounding aquifers and wells. The nature and duration of the effects at any observation point depend on: (1) the amount of energy released by the detonations, (2) the geologic environment, (3) the position of the buried explosive device in relation to the saturated zone, (4) aquifer characteristics, and (5) the distance from point of detonation. Precise measurement of the effects in wells presented numerous technical problems, resulting in the development of specialized techniques. Initially, the effects were observed by measuring the fluctuation of the free water surface in wells; the current technique employs high-resolution pressure transducers deep in the water column. Pneumatic packers may be used to restrict the movement of water into the well. Data are recorded on high-speed oscilloscopes. (USBR)

W70-03375

8I. Fisheries Engineering

CONSERVATION OF NATURAL RESOURCES (FISHING),

For primary bibliographic entry see Field 06E.

W70-03407

GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION),

For primary bibliographic entry see Field 06E.

W70-03590

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE WATER RESOURCES SITUATION IN PUERTO RICO: AN EVALUATION OF PUBLISHED INFORMATION,

Puerto Rico Univ., Mayaguez School of Engineering.

For primary bibliographic entry see Field 06B.

W70-03245

ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY,
 Washington State Univ., Pullman. Dept. of Zoology.
 For primary bibliographic entry see Field 07B.
 W70-03308

BUILDING A COMPUTER-BASED MIS,
 Terminal and Display Systems, Inc.
 James M. McKeever.
J Syst Manage, Vol 20, No 9, p 12-17, Sept 1969. 6 p, 6 fig.

Descriptors: *Data storage and retrieval, *Data storage systems, *Information retrieval, Data collection systems, Data processing, Technology, Systems analysis, Planning, Methodology, Operations research, Computers, Integration, Management

ment, Decision making, Control, Communication, Requirements.

Identifiers: *Computer-based systems, *Information systems, Systems engineering, Man-machine systems, Data elements.

A computer-based management information system (MIS) cannot be implemented successfully unless an organization concedes that management: (1) has an information problem, (2) wants to solve the problem, and (3) is willing to commit the resources for a solution. Five basic steps in designing an MIS are: (1) understanding and approving the objectives of the system by top management, (2) determining information requirements, (3) designing a data base, (4) designing or acquisitioning software, and (5) selecting new or modifying existing hardware. The 5 steps should be performed in the order listed, although there will be some

overlap and parallel activity. An MIS must not remain static. The best examples of management information systems show that new data files should be added to the system, old data files no longer used should be removed from the system, and the contents of remaining data files should be changed frequently to reflect the information needs of management. These needs will come to light only after management has had experience using the system. (USBR)
 W70-03360

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS,
 Geological Survey, Washington, D.C. Office of Water Data Coordination.
 For primary bibliographic entry see Field 07C.
 W70-03473



SUBJECT INDEX

ABSTRACTS		
THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION.		
W70-03245	06B	
ACCESS ROUTES		
PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS,		
W70-03380	06E	
ACCLIMATIZATION		
SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON,		
W70-03522	05C	
THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA,		
W70-03524	05C	
ACCUMULATION RATES		
ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS,		
W70-03525	05C	
ACID MINE WATER		
OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE,		
W70-03434	05B	
ACIDIC SOILS		
DETERMINING PH OF STRIP-MINE SPOILS,		
W70-03281	05A	
ACQUISITION SYSTEM		
THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM,		
W70-03615	07A	
ACTIVATED SLUDGE		
FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS,		
W70-03353	05D	
OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,		
W70-03614	05D	
ADJUDICATION PROCEDURE		
APPEALS IN DRAINAGE AND LEVEE DISTRICT PROCEEDINGS.		
W70-03417	06E	
ADMINISTRATION		
DRAINAGE.		
W70-03347	04A	
DRAINAGE DISTRICTS.		
W70-03566	04A	
CONTROL AND IMPROVEMENT OF NATURAL WATERCOURSES.		
W70-03580	04A	
ADMINISTRATIVE AGENCIES		
LEVEE DISTRICTS.		
W70-03302	04A	
ESTABLISHMENT OF TOWN SANITARY DISTRICTS.		
W70-03344	05E	
LAND AND WATER CONSERVATION FUND ACT.		
W70-03390	06B	
LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR).		
W70-03391	06B	
LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE).		
W70-03392	06B	
LAND AND WATER CONSERVATION ACT (DEPARTMENTS OF COMMERCE AND DEFENSE).		
W70-03393	06B	
LAND AND WATER CONSERVATION ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS).		
W70-03394	06B	
CONSERVANCY DISTRICTS (WATERCOURSES, WATER RIGHTS AND USES, AND CONSTRUCTION AND MAINTENANCE OF RECREATIONAL FACILITIES).		
W70-03395	04A	
COUNTY WATER SUPPLY SYSTEMS.		
W70-03396	04A	
LANDING AND LOADING FACILITIES.		
W70-03414	06E	
WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS).		
W70-03418	06E	
BOATING SAFETY ACT OF 1965.		
W70-03423	06E	
DIVISION OF WATER DEVELOPMENT.		
W70-03491	03B	
STATE WATER POLICY COMMISSION - POWERS AND DUTIES.		
W70-03499	04A	
W70-03514	04A	
WATER DEVELOPMENT AUTHORITY.		
W70-03575	06B	
REMOVAL OF MILLDAMS.		
W70-03576	06E	
WATERS, DRAINS AND LEVEES (DRAINAGE DISTRICTS).		
W70-03584	04A	
GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION).		
W70-03590	06E	
LAND FOR INSTITUTIONAL WATER OR SEWAGE SYSTEM.		
W70-03599	06E	
ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS.		
W70-03611	06B	
ORGANIZATION OF DRAINAGE DISTRICTS.		
W70-03628	04A	
DRAINAGE (CONTROL OF WATER ON THE SURFACE ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS).		
W70-03633	04A	
MUNICIPAL CORPORATIONS (FLOOD PREVENTION).		
W70-03634	04A	
WATER RESOURCES (BOARD OF WATER COMMISSIONERS).		
W70-03636	06E	
WATER RESOURCES (APPLICATIONS TO APPROPRIATE).		
W70-03637	06E	
WATER SUPPLY - SANITATION - DITCHES (ORGANIZATION AND PURPOSES OF CONSERVANCY DISTRICTS).		
W70-03643	04A	
CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION).		
W70-03644	05G	
ADSORPTION		
Possibilities for mineralization of pesticides (Dutch).		
W70-03271	05G	
ADVANCED WASTE TREATMENT		
Filtration of activated sludge secondary effluents through sand and anthracite-sand beds,		
W70-03353	05D	
AEOLIAN SOILS		
TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS,		
W70-03288	02J	
AERATION		
EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS.		
W70-03334	05D	
AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN.		
W70-03625	05G	
AFLATOXIA B1		
THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, ARTEMIA SALINA,		
W70-03528	05C	
AGRICULTURE		
EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS.		
W70-03334	05D	
AIR CONTAMINANT		
PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES.		
W70-03345	05G	
AIR POLLUTION CONTROL		
CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION.		
W70-03364	05G	
ALGAE		
ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM.		
W70-03309	05C	
ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE.		
W70-03335	05C	
PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROPTROPHY IN ALGAL FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS.		
W70-03336	05C	
BIOLOGICAL N2 FIXATION IN LAKES,		
W70-03429	05C	
THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,		
W70-03507	05C	

EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE, W70-03519	05C	AQUIFERS FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER, W70-03257	04B
BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C	A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS, W70-03274	02F
ALGAL GROWTH ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM, W70-03309	05C	MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS, W70-03375	08H
ALGICIDES CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE, W70-03310	05G	WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, W70-03443	02P
ALGONQUIN PARK (ONTARIO) FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO, W70-03323	02H	ARID LANDS GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA, W70-03306	02F
ALLUVIAL CHANNELS STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE, W70-03620	08B	ARIZONA GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA, W70-03267	04B
ALLUVIAL LAND LEVEE DISTRICTS. W70-03302	04A	MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278	02E
AMMONIA THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-03524	05C	ARKANSAS DRAINAGE DISTRICTS. W70-03566	04A
ANALOG MODELS FLOOD FORECASTING IN THE RIVER KITAKAMI, W70-03293	02A	DRAINAGE DISTRICTS (ESTABLISHMENT). W70-03567	04A
ANALYSIS DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS, W70-03502	05A	DRAINAGE DISTRICTS (CONSTRUCTING IMPROVEMENTS). W70-03568	04A
ANALYTICAL METHODS BIOLOGICAL N2 FIXATION IN LAKES, W70-03429	05C	DRAINAGE DISTRICTS (TAXATION). W70-03569	04A
ANALYTICAL TECHNIQUES DETERMINING PH OF STRIP-MINE SPOILS, W70-03281	05A	ARTIFICIAL RECHARGE ISRAEL TURNS TO SEWAGE FOR WATER. W70-03270	05D
AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J	ASHFALLS (VOLCANIC) TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J
MEASUREMENT OF PHOSPHORUS IN WASTEWATER, W70-03331	05A	ASSESSMENTS LEVEE AND DRAINAGE DISTRICTS. W70-03416	04A
NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351	05A	FLOOD CONTROL. W70-03529	04A
A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS, W70-03470	07B	DRAINAGE DISTRICTS (ESTABLISHMENT). W70-03567	04A
ANIMAL POPULATIONS THE EFFECTS OF OIL-Spill REMOVERS ("DETERGENTS") ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513	05C	DRAINAGE DISTRICTS (CONSTRUCTING IMPROVEMENTS). W70-03568	04A
ANTARCTIC VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA, W70-03461	02C	WATERS, DRAINS AND LEVEES (DRAINAGE DISTRICTS). W70-03584	04A
ANTHRACITE FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D	DRAINAGE SUBDISTRICTS. W70-03585	04A
APPROPRIATION WATER RESOURCES (APPROPRIATION OF WATER RESOURCES AND RIGHTS). W70-03635	06E	AUTOMATIC CONTROL HYDRAULIC CONTROLS OF WATER LEVEL, W70-03373	08C
WATER RESOURCES (BOARD OF WATER COMMISSIONERS). W70-03636	06E	AVERAGE FLOW MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS, W70-03280	02E
WATER RESOURCES (APPLICATIONS TO APPROPRIATE). W70-03637	06E	AVOIDANCE AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C
AQUATIC DRIFT DRIFTING AND FLOATING TIMBER. W70-03426	06E	BAHAMAS CONSOLIDATION AND SEDIMENTATION-COMPRESSTION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448	08E
AQUATIC INSECTS THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C	BASE FLOW BASE-FLOW STUDIES OF LEON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968, W70-03466	02E
AQUATIC MICROBIOLOGY EDGARDO BALDI MEMORIAL LECTURE CURRENT CONCEPTS IN AQUATIC MICROBIOLOGY, W70-03510	05C	BAYOUS NAVIGABLE WATERS. W70-03337	04A
AQUATIC PLANTS FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD-WATER LAKES, W70-03307	02H	BAYS TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DADE COUNTY, FLORIDA, W70-03268	02L
		RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES, W70-03478	02L
		BEACH EROSION CONSERVATION OF NATURAL RESOURCES (SHORE EROSION). W70-03405	04D
		BEACHES THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B

LAKE MICHIGAN BEACH SURVEY 1968. W70-0339	05C	THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, ARTEMIA SALINA, W70-03528	05C
A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO. W70-03472	02H	INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621	05C
BEARINGS EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT, W70-03369	08C	SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C
BED FORMS (RIVER) STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE, W70-03620	08B	BIOCHEMICAL OXYGEN DEMAND BIODEGRADABLE DETERGENTS RECENT PROBLEMS AND PROGRESS. W70-03530	05D
BED LOAD A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY, W70-03301	02A	AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY. W70-03531	05D
SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA, W70-03457	02J	*AN ANSWER TO STREAM POLLUTION*-STREAM POLLUTION REDUCTION PROGRAM FOR FINISHING PLANT. W70-03537	05D
THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J	BIOCHEMISTRY METHODS BIOLOGICAL N ₂ FIXATION IN LAKES, W70-03429	05C
BEDS TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J	BIODEGRADATION BIODEGRADABLE DETERGENTS RECENT PROBLEMS AND PROGRESS. W70-03530	05D
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA, W70-03386	06E	BIOGEOGRAPHY PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY I), W70-03387	06E	BIOLOGICAL CONCENTRATION BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY II), W70-03388	06E	BIOLOGICAL PROPERTIES PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROPTROPHY IN ALGAL FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS, W70-03336	05C
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES), W70-03389	06E	BIOLOGICAL TREATMENT AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY. W70-03531	05D
BENEFICIAL USE WATER RESOURCES (APPROPRIATION OF WATER RESOURCES AND RIGHTS). W70-03635	06E	BLEACHING WASTES *AN ANSWER TO STREAM POLLUTION*-STREAM POLLUTION REDUCTION PROGRAM FOR FINISHING PLANT. W70-03537	05D
WATER RESOURCES (BOARD OF WATER COMMISSIONERS). W70-03636	06E	BLOOD EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C
WATER RESOURCES (APPLICATIONS TO APPROPRIATE). W70-03637	06E	BLOOD ANALYSIS SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C
BENEFITS THE FEDERAL VIEW OF DAMAGES AND BENEFITS, W70-03361	06E	BOATING REGULATIONS WATERCRAFT NAVIGATION. W70-03408	06E
DRAINAGE DISTRICTS (ESTABLISHMENT). W70-03567	04A	BOATING SAFETY ACT OF 1965. W70-03423	06E
BENTHIC FAUNA COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES, W70-03315	02H	BOATS PENN CENTRAL CO V BUCKLEY AND CO, INC (RAILROAD DENIED INJUNCTIVE RELIEF). W70-03298	04A
BENTHIC FLORA A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS, W70-03325	05C	BOHR EFFECT SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C
BENTHOS ECOLOGY OF CHIRONOMIDAE, CHAOBRIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES. W70-03333	02H	BONDS WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS). W70-03418	05E
BERMUDA THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS, W70-03468	02K	LEVEES. W70-03581	04A
BIBLIOGRAPHIES THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245	06B	BOTTOM SEDIMENTS RECENT SEDIMENTATION IN THE BERING SEA, W70-03500	02L
ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308	07B	BOUNDARIES (PROPERTY) DRAINAGE DISTRICTS (ANNEXATION AND DETACHMENT OF LANDS). W70-03565	04A
CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS, W70-03476	02L	CONCURRENT JURISDICTION OF THE MISSISSIPPI RIVER. W70-03600	06E
BIOASSAY THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS, RAFINESQUE), W70-03518	05C	JURISDICTION OVER BOUNDARY WATERS. W70-03601	06E
SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TINSAN), W70-03523	05C	HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS). W70-03642	06E
THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES, W70-03526	05C	BREAKDOWN PRODUCTS THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS, RAFINESQUE), W70-03518	05C

SUBJECT INDEX

BREAKWATERS PATY V TOWN OF PALM BEACH (GROIN-ORIGINATING LAND DAMAGE). W70-03330	04A	W70-03553	08B
BRIDGE COMPANIES BRIDGE COMPANIES. W70-03409	06E	BURROWS X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS, W70-03286	02J
BRIDGE CONSTRUCTION PIRMAN V FLORIDA STATE IMPROVEMENT COMM'N, AND STATE RD. DEPT OF FLORIDA (BRIDGE CONSTRUCTION). W70-03300	04A	CALCAREOUS SEDIMENTS CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448	08E
BRIDGE COMPANIES. W70-03409	06E	CALCITE DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES, W70-03285	02J
BRIDGES AND VIADUCTS. W70-03533	04A	CALCIUM CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN, W70-03316	02H
CONSTRUCTION AND MAINTENANCE OF BRIDGES. W70-03607	06E	CALCIUM STRATIFICATION CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN, W70-03316	02H
BRIDGES (CONSTRUCTION OF BRIDGES BY COUNTY COURTS). W70-03608	06E	CALIBRATIONS PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING, W70-03287	02J
HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS). W70-03642	06E	CALIFORNIA I. PRODUCTIVITY PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA, W70-03508	05C
BRIDGE DESIGN BRIDGE COMPANIES (CONSTRUCTION OF BRIDGES AND INTERFERENCE WITH NAVIGATION). W70-03589	06E	CAPITAL COSTS MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS, W70-03610	05G
BRIDGES PENN CENTRAL CO V BUCKLEY AND CO, INC (RAILROAD DENIED INJUNCTIVE RELIEF). W70-03298	04A	CARBON DIOXIDE EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESmus CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D
BRIDGE COMPANIES. W70-03409	06E	SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C
BRIDGES AND VIADUCTS. W70-03533	04A	CARBONATE ROCKS DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES, W70-03285	02J
TURNPIKE BRIDGE ACROSS THE DELAWARE RIVER. W70-03571	06E	SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRIAL CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ('SALT LAKE'), TURKEY, W70-03446	02J
BRIDGE COMPANIES (CONSTRUCTION OF BRIDGES AND INTERFERENCE WITH NAVIGATION). W70-03589	06E	STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS, W70-03447	02J
CRIMINAL OFFENSES ARSON AND FRAUD. W70-03593	06E	THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS, W70-03468	02K
STATE HIGHWAY SYSTEM. W70-03603	04A	CARBONATES CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN, W70-03316	02H
BRIDGES AND CROSSINGS. W70-03605	06E	CARDIGAN BAY(WALES) RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES, W70-03478	02L
CONSTRUCTION AND MAINTENANCE OF BRIDGES. W70-03607	06E	CARP UPTAKE AND RETENTION OF MALATHION BY THE CARP, W70-03516	05C
BRIDGES (CONSTRUCTION OF BRIDGES BY COUNTY COURTS). W70-03608	06E	CATALOG OF INFORMATION ON WATER DATA CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473	07C
DAMS AND BRIDGES (PROCEDURES REGARDING WATER POWER PERMITS). W70-03640	06E	CATHODIC PROTECTION THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION, W70-03366	08C
PUBLIC DOMAIN AND TRUST FUNDS (DAMS AND BRIDGES). W70-03641	06E	CAUSEWAYS WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03597	06E
HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS). W70-03642	06E	CAVITATION THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION, W70-03366	08C
BRINE SHRIMP THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, ARTEMIA SALINA, W70-03528	05C	CEDAR RAPIDS THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT, W70-03342	06F
BRINES GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966, W70-03279	02B	CHANNEL IMPROVEMENT VACATION OR RELOCATION OF WATERCOURSES - CONSTRUCTION OF DAMS. W70-03521	04A
BUBBLES LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS, W70-03451	01B	CHANNEL MORPHOLOGY LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES, W70-03255	02E
BUILDING MATERIALS CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372	08F		
BULB TURBINES EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT, W70-03369	08C		
BUOYANCY ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS, W70-03545	08B		
BUOYANT PLUME DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING,			

CHAOBORIDAE		COLOMBIA
ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, W70-03333	02B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA, W70-03481
CHEMICAL REACTIONS		02B
OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434	05B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA, W70-03482
CHEMISTRY		02B
EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART H. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03486
CHICAGO		02B
THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B	COLUMBIA RIVER THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER, W70-03546
CHINOOK SALMON		05C
EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRAE AND FIN RAYS IN YOUNG CHINOOK SALMON, W70-03557	05C	COMMERCIAL FISHING FISH TRAPS LICENSING AND REGULATION. W70-03638
CHIRONOMIDA		06E
CHIRONOMIDA AND THE STUDY OF LAKE TYPES, W70-03332	02H	COMMUNICATION TELEGRAPH AND TELEPHONES. W70-03427
CHIRONOMIDAE		06E
ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, W70-03333	02H	COMPENSATION DRIFTING AND FLOATING TIMBER. W70-03426
CHLORINATED HYDROCARBON PESTICIDES		06E
SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C	ACQUISITION OF LAND TO PREVENT CONTAMINATION. W70-03532
CHLORINATED HYDROCARBONS		05G
A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	COMPUTER PROGRAMS ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428
CHROMIUM		10
RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIRDNERI) TO STRESS, W70-03527	05C	COMPUTER-EASED SYSTEMS BUILDING A COMPUTER-BASED MIS, W70-03360
CITIES		05G
WATER RESERVOIR SYSTEMS. W70-03435	04A	CONCRETE TECHNOLOGY CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372
VACATION OR RELOCATION OF WATERCOURSES - CONSTRUCTION OF DAMS. W70-03521	04A	08F
BRIDGES AND VIADUCTS. W70-03533	04A	CONCRETE-POLYMER MATERIALS CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372
AUTHORITY OF CITIES TO DEVELOP SEWAGE SYSTEMS, AND TO IMPROVE LAKES AND WATERCOURSES. W70-03534	05G	CONCURRENT JURISDICTION JURISDICTION OVER BOUNDARY WATERS. W70-03601
MUNICIPAL CORPORATIONS (PUBLIC SERVICES). W70-03579	06E	06E
CLAY MINERALS		CONDEMNATION THE FEDERAL VIEW OF DAMAGES AND BENEFITS, W70-03361
DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES, W70-03285	02J	06E
CLAYS		ACQUISITION OF LAND TO PREVENT CONTAMINATION. W70-03532
NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION, W70-03265	05A	05G
CLEANING		WATER AND WATERWORKS COMPANIES. W70-03587
CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS. W70-03349	05C	06E
CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION. W70-03364	05G	CONDUCTS WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03596
CLIMATOLOGY		06E
A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO, W70-03645	02B	CONFERENCES ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION- INFORMATION CENTER. W70-03379
CLOGGING		05G
TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA, W70-03357	04A	CONSERVANCY DISTRICTS CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION). W70-03644
CLOSED CONDUIT FLOW		05G
COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION, W70-03295	02E	CONSERVATION ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION- INFORMATION CENTER. W70-03379
COASTAL AQUIFER		04A
FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER, W70-03257	04B	WATER SUPPLY - SANITATION - DITCHES (ORGANIZATION AND PURPOSES OF CONSERVANCY DISTRICTS). W70-03643
COASTAL STRUCTURES		04A
WHARVES, DOCKS AND FERRIES. W70-03570	06E	CONSOLIDATION CONSOLIDATION AND SEDIMENTATION-COMPRESSTION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448
COLLECTING HYDROLOGIC DATA		08C
THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAINARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM, W70-03615	07A	CONTAMINANTS ASSESSING OUTDOOR INSULATION. W70-03368
CONTAMINATION		08C
ASSESSING OUTDOOR INSULATION. W70-03368		CONTINENTAL SHELF A UNITED STATES POLICY FOR THE WET FRONTIER, W70-03627
CONTINENTAL SLOPE		06E
A UNITED STATES POLICY FOR THE WET FRONTIER,		

CON-DES

SUBJECT INDEX

W70-03627	06E	DAMS VACATION OR RELOCATION OF WATERCOURSES - CONSTRUCTION OF DAMS.
CONVECTION EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER, W70-03464	02C	W70-03521
COOLING COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (IN RUSSIAN), W70-03539	05C	04A
THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D	PUBLIC UTILITIES AND CARRIERS. W70-03586
COOLING WATER EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS, W70-03547	05C	06E
WATER SUPPLY TO THERMAL POWER PLANTS, W70-03548	03E	DAMS, MILLS AND ELECTRIC POWER. W70-03609
COOSA RIVER THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY, W70-03550	05C	PUBLIC DOMAIN AND TRUST FUNDS (DAMS AND BRIDGES). W70-03641
CORES A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS, W70-03470	07B	06E
CORRELATION ANALYSIS REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263	07C	DATA COLLECTIONS QUALITY OF SURFACE WATERS OF SOUTH CAROLINA A SUMMARY OF DATA, 1945-1968, W70-03266
RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES, W70-03487	02E	05B
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E	RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459
CORROSION POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND, W70-03365	08G	02F
CORROSION CONTROL POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND, W70-03365	08G	CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473
CORROSION TESTS POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND, W70-03365	08G	07C
COST ANALYSIS REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER, W70-03453	03A	CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS, W70-03476
COST PER UNIT PRODUCT COST HANDBOOK FOR INDUSTRIAL WATER USES, W70-03432	06C	02L
CRATERS NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362	08H	THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MARYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM, W70-03615
CULTURES EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D	07A
CURRENT METERS GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA, W70-03253	05B	DATA PROCESSING REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263
ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY, W70-03259	02L	10
CURRENTS(WATER) GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA, W70-03253	05B	CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473
NEPHROPOD LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN, W70-03463	02L	07C
CYANOPHYTA CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLOROAPHTHOQUINONE, W70-03310	05G	DATA STORAGE AND RETRIEVAL BUILDING A COMPUTER-BASED MIS, W70-03360
DAM CONSTRUCTION DAMS, MILLS AND ELECTRIC POWER. W70-03609	04A	10
DAMS AND BRIDGES (PROCEDURES REGARDING WATER POWER PERMITS). W70-03640	06E	DEGRADATION THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS, RAFINESQUE), W70-03518
DAMAGES THE FEDERAL VIEW OF DAMAGES AND BENEFITS, W70-03361	06E	05C
ESTABLISHMENT OF DRAINAGE AND LEVEE DISTRICTS. W70-03583	04A	DELAWARE RIVER WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269
DELAWARE RIVER PORT AUTHORITY (JOINT COMPACT WITH NEW JERSEY). W70-03572	06E	05B
DELAWARE RIVER PORT AUTHORITY (PURPOSES). W70-03573	06E	DELAWARE RIVER PORT AUTHORITY (REVENUE). W70-03574
SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES. W70-03639	06E	06E
DELAWARE RIVER BASIN WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269	05B	SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES. W70-03639
DELAWARE RIVER BASIN COMMISSION WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269	05B	DELAWARE RIVER BASIN
DELTA GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L	WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269
DENSITY CURRENTS EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER, W70-03464	02C	05B
STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543	08B	DELTA GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469
DEPOSITION(SEDIMENTS) VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE BLAKE PLATEAU, W70-03462	02J	DENSITY CURRENTS EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER, W70-03464
DESALINATION PLANTS REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER, W70-03453	03A	STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543

DETERGENTS

THE EFFECTS OF OIL-SPILL REMOVERS ("DETERGENTS") ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY.
W70-03513

05C

BIODEGRADABLE DETERGENTS RECENT PROBLEMS AND PROGRESS.
W70-03530.

05D

DEUTERIUM

VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA,
W70-03461

02C

DIAGENESIS

DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES.
W70-03285

02J

STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS.
W70-03447

02J

THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS,
W70-03468

02K

IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO,
W70-03471

02J

DIATOMS

A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS.
W70-03325

05C

DIFFUSION

JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY.
W70-03555

08B

DIGITAL SIGNALS

THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM,
W70-03615

07A

DIMENSIONAL ANALYSIS

FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER,
W70-03257

04B

DISCHARGE MEASUREMENT

MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS.
W70-03280

02E

DISPERSION

GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA,
W70-03253

05B

BRANCHING-TYPE MODELS OF FLOW THROUGH POROUS MEDIA,
W70-03262

02F

DISSOLVED OXYGEN

AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN,
W70-03625

05G

DISSOLVED SULPHATE

DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,
W70-03502

05A

DITCHES

WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS).
W70-03402

04A

WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES).
W70-03403

04A

WATER SUPPLY--SANITATION--DITCHES.
W70-03404

04A

ESTABLISHMENT OF DRAINAGE DISTRICTS BY MUTUAL CONSENT.
W70-03419

04A

BRIDGES AND CROSSINGS.
W70-03605

06E

DIURESIS

THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA,
W70-03524

05C

DIURNAL OXYGEN CURVES

ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM,
W70-03309

05C

DIVERSION

WALLACE & SCHNEIDER (SURFACE DRAINAGE).
W70-03321

04A

PAYMENTS TO STATE FOR WATERS DIVERTED.
W70-03517

06D

DOCKS

WHARVES, DOCKS AND FERRIES.
W70-03570

06E

DOCUMENTATION

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS,
W70-03473.

07C

DOLomite

SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ("SALT LAKE"), TURKEY,
W70-03446

02J

DOMESTIC WASTES

AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY.
W70-03531

05D

HEALTH, WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY).
W70-03632

05F

DOMESTIC WATER

DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES,
W70-03247

06D

ACQUISITION OF LAND TO PREVENT CONTAMINATION.
W70-03532

05G

DIAGENESIS

SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ("SALT LAKE"), TURKEY,
W70-03446

02J

DRAIN TILES

TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA,
W70-03357

04A

DRAINAGE

ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION,
W70-03449

02D

THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,
W70-03495

02G

DRAINAGE SUBDISTRICTS.

W70-03585

04A

MAINTENANCE OF PUBLIC ROADS.

W70-03606

04A

APPOINTMENT, POWERS, AND DUTIES OF DRAINAGE BOARD.
W70-03618

04A

DRAINAGE BASIN MORPHOLOGY

RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES,
W70-03487

02E

DRAINAGE DISTRICTS

DRAINAGE.
W70-03347

04A

LEVEE AND DRAINAGE DISTRICTS.

W70-03416

04A

APPEALS IN DRAINAGE AND LEVEE DISTRICT PROCEEDINGS.
W70-03417

06E

WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS).
W70-03418

06E

ESTABLISHMENT OF DRAINAGE DISTRICTS BY MUTUAL CONSENT.
W70-03419

04A

DRAINAGE DISTRICTS (ANNEXATION AND DETACHMENT OF LANDS).
W70-03565

04A

DRAINAGE DISTRICTS.

W70-03566

04A

DRAINAGE DISTRICTS (ESTABLISHMENT).
W70-03567

04A

DRAINAGE DISTRICTS (CONSTRUCTING IMPROVEMENTS).
W70-03568

04A

DRAINAGE DISTRICTS (TAXATION).
W70-03569

04A

DRAINAGE AND LEVEE DISTRICTS.

W70-03582

04A

ESTABLISHMENT OF DRAINAGE AND LEVEE DISTRICTS.
W70-03583

04A

WATERS, DRAINS AND LEVEES (DRAINAGE DISTRICTS).
W70-03584

04A

DRAINAGE SUBDISTRICTS.

W70-03585

04A

APPOINTMENT, POWERS, AND DUTIES OF DRAINAGE BOARD.
W70-03618

04A

ORGANIZATION OF DRAINAGE DISTRICTS.

W70-03628

04A

DRAINAGE (CONTROL OF WATER ON THE SURFACE) ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS.
W70-03633

04A

DRAINAGE ENGINEERING MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL.
W70-03343

04C

DRA-EST

SUBJECT INDEX

DRAINAGE PROGRAMS ORGANIZATION OF DRAINAGE DISTRICTS. W70-03628	04A	HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551 05A
DRAINAGE SYSTEMS MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL, W70-03483	04C	EDUCATION REPORT OF COMMITTEE ON POLLUTION. W70-03378 05G
WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES). W70-03403	04A	EGGS EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRATE AND FIN RAYS IN YOUNG CHINOOK SALMON, W70-03557 05C
WATER SUPPLY--SANITATION--DITCHES. W70-03404	04A	ELECTRIC INSULATION ASSESSING OUTDOOR INSULATION, W70-03368 08C
GRIMES V POLK COUNTY (PUBLIC RIGHTS IN PRIVATE DRAINAGE SYSTEMS). W70-03562	04A	ELECTRIC POWER PLANTS DAMS, MILLS AND ELECTRIC POWER. W70-03609 04A
DRAINAGE DISTRICTS (ANNEXATION AND DETACHMENT OF LANDS). W70-03565	04A	ELECTRIC POWER PRODUCTION FLOW BETWEEN A RESERVOIR AND A HEADPOND, W70-03355 08C
DRAINAGE AND LEVEE DISTRICTS. W70-03582	04A	ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND FUTURE DEVELOPMENT OF GRAND COULEE DAM, W70-03358 08C
DRAINAGE WATER WALLACE V SCHNEIDER (SURFACE DRAINAGE). W70-03321	04A	MHD POWER GENERATION CURRENT STATUS, W70-03374 08C
DRAINS WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS). W70-03402	04A	ELECTRICAL INSULATORS ASSESSING OUTDOOR INSULATION, W70-03368 08C
WATER SUPPLY--SANITATION--DITCHES. W70-03404	04A	EMINENT DOMAIN DUVAL ENGINEERING AND CONTRACTING CO V SALES (RIPARIAN RIGHTS). W70-03563 06E
ESTABLISHMENT OF DRAINAGE DISTRICTS BY MUTUAL CONSENT. W70-03419	04A	CONTROL AND IMPROVEMENT OF NATURAL WATERCOURSES. W70-03580 06A
DRAWDOWN A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS. W70-03274	02F	EMISSION PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES. W70-03345 05G
DRILLING WATER WELLS. W70-03424	04B	EMULSIFIERS CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS. W70-03349 05C
DROUGHTS GENERALIZING DRY-DAY FREQUENCY DATA. W70-03481	02B	ENDRIN EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314 05C
DUNES INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER- POINTBAR DEPOSITS, LOWER RHINE). W70-03289	02J	INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621 05C
DURSRAN AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C	AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622 05C
DYEING WASTES AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY. W70-03531	05D	ENERGY EFFICIENCY THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION, W70-03313 02K
DYNAMIC PROGRAMMING AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, W70-03619	05G	ENTRAINMENT ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS, W70-03545 08B
EARTH THE PRINCIPLE OF REINFORCED EARTH, W70-03359	08D	ENTRAINMENT RATE DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY' BY G. ABRAHAM, W70-03560 08B
EARTH DAMS VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D	ENVIRONMENT CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION. W70-03364 05G
EARTHQUAKE ENGINEERING VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D	ENVIRONMENTAL EFFECTS THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN US RESERVOIRS, W70-03324 02H
EARTHWORKS THE PRINCIPLE OF REINFORCED EARTH, W70-03359	08D	ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE, W70-03335 05C
ECOLOGICAL TECHNIQUES ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308	07B	ENVIRONMENTAL SANITATION THE ORGANIZATION, PURPOSES, AND POWERS OF A SANITARY DISTRICT. W70-03399 05G
ECOLOGY ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, W70-03333	02R	DUTIES OF SANITARY DISTRICTS REGARDING POLLUTION, WATER SUPPLY, MOSQUITO CONTROL, AND INVESTIGATIONS OF RAINFALL AND STREAMFLOW. W70-03400 05G
ECONOMIC EFFICIENCY THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C	EQUATIONS UNIVERSAL FORMULA FOR UNIFORM FLOW, W70-03248 08B
AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, W70-03619	05G	EROSION CONTROL CONSERVATION OF NATURAL RESOURCES (SHORE EROSION). W70-03405 04D
ECONOMIC EVALUATION ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G	ESTIMATING MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS,
EDDY CONDUCTIVITY		

SUBJECT INDEX

EST-FIS

W70-03280	02E	W70-03612	05D
ESTUARIES ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY, W70-03259	02L	FIN RAYS EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRAE AND FIN RAYS IN YOUNG CHINOOK SALMON, W70-03557	05C
WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269	05B	FINANCING REPORT OF COMMITTEE ON POLLUTION, W70-03378	05G
GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L	LEVEE AND DRAINAGE DISTRICTS. W70-03416	04A
RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES, W70-03478	02L	DRAINAGE DISTRICTS (CONSTRUCTING IMPROVEMENTS). W70-03568	04A
ESTUARINE ENVIRONMENT FISH AND POWER PLANTS, W70-03250	05C	LEVEES. W70-03581	04A
ETHYL MERCURY PHOSPHATE SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TMSAN), W70-03523	05C	FINISHING WASTES 'AN ANSWER TO STREAM POLLUTION'-STREAM POLLUTION REDUCTION PROGRAM FOR FINISHING PLANT. W70-03537	05D
EUTROPHICATION A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA, W70-03260	05C	FIRN VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA, W70-03461	02C
CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3- DICHLORONAPHTHOQUINONE, W70-03310	05G	FISH FISHING - UNLAWFUL METHODS. W70-03299	06E
A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02H	TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT, W70-03556	05C
LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET, W70-03322	02H	GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION). W70-03590	06E
NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA, W70-03511	05C	FISH BEHAVIOR AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDNERII RICHARDSON, W70-03554	05C
THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT, W70-03512	05C	TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT, W70-03556	05C
EVAPOTRANSPIRATION ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION, W70-03449	02D	AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C
EXCRETION FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES, W70-03307	02H	FISH BLOOD SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C
EXTENSOMETERS MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, W70-03455	02G	FISH CONSERVATION SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES. W70-03639	06E
EXTREME VALUE ANALYSIS RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA, W70-03484	02B	FISH FOOD ORGANISMS EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE, W70-03317	02H
FEDERAL GOVERNMENT		FISH MANAGEMENT GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION). W70-03590	06E
FERRIES SUPERVISION OF LOCAL IMPROVEMENTS. W70-03602	06E	FISH PHYSIOLOGY SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C
FERTILIZATION FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO, W70-03323	02H	RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIRDNERI) TO STRESS, W70-03527	05C
FERTILIZERS POISONING THE WELLS. W70-03276	05B	FISH PRODUCTION EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE, W70-03317	02H
EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE, W70-03317	02H	FISH PROPAGATION GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION). W70-03590	06E
FIELD CONTROL RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT, W70-03371	08F	FISH REPRODUCTION REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SUBLETHAL CONCENTRATIONS OF DDT, W70-03515	05C
FILMS SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES, W70-03646	03A	FISH TRAPS FISH TRAPS LICENSING AND REGULATION. W70-03638	06E
FILTRATION FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D	FISHING FISHING - UNLAWFUL METHODS. W70-03299	06E
EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE,		CONSERVATION OF NATURAL RESOURCES (FISHING). W70-03407	06E
		WATER TEMPERATURE AND SPRING FISHING, NORRIS RESERVOIR, TENNESSEE, W70-03559	05C

FISHING GEAR		W70-03299	04A
FISHING - UNLAWFUL METHODS.			
WATERS AND WATERCOURSES	CRIMINAL OFFENSES.	W70-03596	06E
FISH TRAPS	LICENSING AND REGULATION.	W70-03638	06E
FLAGELLATES			
PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROtROPHY IN ALGAL FLAGELLATES	CONDITIONALLY EXPRESSED CHARACTERISTICS.	W70-03336	05C
FLASHOVER			
ASSESSING OUTDOOR INSULATION,		W70-03368	08C
FLOCCULATION			
NONTONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION,		W70-03265	05A
FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS,		W70-03353	05D
FLOOD CONTROL			
FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH.		W70-03340	06B
THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,		W70-03342	06F
MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL,		W70-03343	04C
CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS).		W70-03406	04A
WATER RESERVOIR SYSTEMS.		W70-03435	04A
GRACI V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR NEGLIGENCE IN CONSTRUCTION OF NAVIGATION AID PROJECT).		W70-03444	04A
FLOOD CONTROL.		W70-03529	04A
SOIL AND WATER CONSERVATION COMMISSION.		W70-03578	06B
MUNICIPAL CORPORATIONS (FLOOD PREVENTION).		W70-03634	04A
FLOOD DAMAGE			
FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.		W70-03261	04A
FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.		W70-03272	04A
FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.		W70-03273	04A
FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH.		W70-03340	06B
GRACI V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR NEGLIGENCE IN CONSTRUCTION OF NAVIGATION AID PROJECT).		W70-03444	04A
FLOOD FORECASTING			
FLOOD FORECASTING IN THE RIVER KITAKAMI,		W70-03293	02A
FLOOD PLAIN MANAGEMENT			
FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH.		W70-03340	06B
FLOOD PLAINS			
FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH.		W70-03340	06B
LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,		W70-03341	06F
THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,		W70-03342	06F
FLOOD PROTECTION			
FLOOD CONTROL.		W70-03529	04A
FLOOD ROUTING			
FLOOD ROUTING BY DIRECT INTEGRATION METHOD,		W70-03294	02E
COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION,		W70-03295	02E
FLOODING			
FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH.		W70-03340	06B
FLOODS			
FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.		W70-03261	04A
FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.		W70-03272	04A
FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.		W70-03273	04A
EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA),		W70-03458	02E
MUNICIPAL CORPORATIONS (FLOOD PREVENTION).		W70-03634	04A
FLORIDA			
A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,		W70-03260	05C
TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DALE COUNTY, FLORIDA,		W70-03268	02L
FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.		W70-03273	04A
PIRMAN V FLORIDA STATE IMPROVEMENT COMM'N, AND STATE RD. DEP'T OF FLORIDA (BRIDGE CONSTRUCTION).		W70-03300	04A
PATY V TOWN OF PALM BEACH (GROIN-ORIGINATING LAND DAMAGE).		W70-03330	04A
WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66,		W70-03443	02F
DUVAL ENGINEERING AND CONTRACTING CO V SALES (RIPARIAN RIGHTS).		W70-03563	06E
FLOW			
FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER,		W70-03257	04B
PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES).		W70-03592	04A
FLOW RESISTANCE			
STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE,		W70-03620	08B
FOAM SEPARATION			
FOAM SEPARATION OF KRAFT PULPING WASTES.		W70-03350	05D
FOAMING			
BIODEGRADABLE DETERGENTS RECENT PROBLEMS AND PROGRESS.		W70-03530	05D
FOOD WEBS			
BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE,		W70-03520	05C
FOREBAYS			
FLOW BETWEEN A RESERVOIR AND A HEADPOND,		W70-03355	08C
FREEZING			
EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER.		W70-03464	02C
FRENCH GUIANA			
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS,		W70-03463	02B
FREQUENCY ANALYSIS			
COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY,		W70-03256	07C
FRESH WATER			
LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS.		W70-03451	01B
FUNGICIDES			
A NEW POLLUTION PROBLEM,		W70-03456	05B
SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, SETTING AGENTS AND MISCELLANEOUS SUBSTANCES,		W70-03623	05C
FUTURE PLANNING (PROJECTED)			
MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST.			

W70-03376	08C	GROUNDWATER BASINS GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA, W70-03267	04B
GAMETES REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SOBLETAL CONCENTRATIONS OF DET., W70-03515	05C		
GARBAGE DISPOSAL HEALTH WATER, SEWAGE, GARBAGE. W70-03629	05F		
GAS SAND OIL AND GAS. W70-03425	08G		
GASES MHD POWER GENERATION CURRENT STATUS, W70-03374	08C		
GEOMORPHOLOGY TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J		
GLACIATION RECENT SEDIMENTATION IN THE BERING SEA, W70-03500	02L		
GOVERNMENT FINANCE WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS). W70-03418	06E		
GRADED TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J		
GRADEL REDDING TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J		
GRAND COULEE DAM ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND FUTURE DEVELOPMENT OF GRAND COULEE DAM, W70-03358	08C		
THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER, W70-03546	05C		
GREAT LAKES GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA, W70-03253	05B		
A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02H		
COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES, W70-03315	02H		
GREAT LAKES COMMISSION GREAT LAKES BASIN COMPACT. W70-03577	06B		
GREAT SALT LAKE GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966, W70-03279	02H		
GROUNDWATER HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO, W70-03254	02F		
HYDROGEOLOGY OF A VOLCANIC ISLAND CHE JU DO, KOREA, W70-03258	02F		
GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA, W70-03267	04B		
MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278	02E		
GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA, W70-03306	02F		
IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B		
RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH, W70-03454	02F		
RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459	02F		
OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY, TEXAS, W70-03460	02F		
GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL MINNESOTA, W70-03477	02F		
CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE, W70-03501	05B		
GROWTH DISTURBANCES THE EFFECTS OF OIL-SPILL REMOVERS ('DETERGENTS') ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513	05C		
GROWTH RATES EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE, W70-03519	05C		
GUAYANA RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM, W70-03480	02B		
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS, W70-03483	02B		
GULF COASTAL PLAIN HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN, W70-03445	02J		
HARDNESS AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDNERII RICHARDSON, W70-03554	05C		
HARDNESS(WATER) STUDIES RELATING TO WATER MINERALIZATION AND HEALTH, W70-03252	05C		
FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES, W70-03307	02H		
HARDY CONTINUOUS PLANKTON RECORDER PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H		
HARRIS COUNTY(TEX) RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459	02F		
HAWAII CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS, W70-03476	02L		
SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII, W70-03613	02A		
HEAT BALANCE THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D		
HEAT FLOW HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540	05B		
HEAT TRANSFER THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D		
HEATED WATER HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540	05B		
HEAD ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS, W70-03525	05C		
HERBICIDES EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE, W70-03519	05C		
SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C		
HETEROTROPHY PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROTROPHY IN ALGAL FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS, W70-03336	05C		
HIGHWAY MAINTENANCE			

STATE HIGHWAY SYSTEM. W70-03603	04A	W70-03474	07A
MAINTENANCE OF PUBLIC ROADS. W70-03606	04A	HYPOLIMNION HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAFY RESERVOIR (1958-1960), W70-03541	02H
HIGHWAY RELOCATION INUNDATED HIGHWAYS. W70-03604	04A	HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551	05A
HIGHWAYS TURNPIKE BRIDGE ACROSS THE DELAWARE RIVER. W70-03571	06E	IDaho HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO, W70-03254	02F
STATE HIGHWAY SYSTEM. W70-03603	04A	A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO, W70-03645	02B
INUNDATED HIGHWAYS. W70-03604	04A	ILLINOIS LAKE MICHIGAN BEACH SURVEY 1968. W70-03339	05C
BRIDGES AND CROSSINGS. W70-03605	06E	DRAINAGE. W70-03347	04A
MATNTENANCE OF PUBLIC ROADS. W70-03606	04A	ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH THEORIES TO RETAIN CONTROL OF THE LAKES), W70-03385	06E
HUDSON RIVER FISH AND POWER PLANTS, W70-03250	05C	DRAINAGE DISTRICTS (ANNEXATION AND DETACHMENT OF LANDS). W70-03565	04A
HUMAN DISEASES STUDIES RELATING TO WATER MINERALIZATION AND HEALTH, W70-03252	05C	DRAINAGE (CONTROL OF WATER ON THE SURFACE ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS). W70-03633	04A
HUMAN PATHOLOGY STUDIES RELATING TO WATER MINERALIZATION AND HEALTH, W70-03252	05C	IMPOUNDED WATERS HEALTH AND SAFETY (MALARIA). W70-03591	06E
HUNGARY KARSTIC WATER RESEARCH IN HUNGARY, W70-03264	02F	IMPOUNDMENTS HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540	05B
HYDRAULIC MACHINERY EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERELANT, W70-03369	08C	THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY, W70-03550	05C
HYDRAULIC MODELS THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL, W70-03475	02E	IMPROVEMENTS WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS). W70-03401	04A
THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW, W70-03492	02A	WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS). W70-03402	04A
USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-03549	05B	SUPERVISION OF LOCAL IMPROVEMENTS. W70-03602	06E
HYDRAULIC REGIME OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS, W70-03614	05D	INDIANA FISHING - UNLAWFUL METHODS. W70-03299	06E
HYDRAULIC TURBINES THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION, W70-03366	08C	MUNICIPAL CORPORATIONS (FLOOD PREVENTION). W70-03634	04A
EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT, W70-03369	08C	INDUSTRIAL WASTES MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES ON LAGOON ECOLOGY, W70-03312	05C
HYDROGEN ION CONCENTRATION DETERMINING PH OF STRIP-MINE SPOILS, W70-03281	05A	CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT, W70-03433	05D
HYDROGEN SULFIDE HYDROGEN SULFIDE ODOR THRESHOLD, W70-03275	05A	POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS, W70-03438	05G
HYDROGEN SULFIDE ODOR DETERMINATION HYDROGEN SULFIDE ODOR THRESHOLD, W70-03275	05A	PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL. W70-03439	05G
HYDROLOGIC DATA REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263	07C	AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, W70-03619	05G
CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473	07C	INDUSTRIAL WATER COSTS THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C
THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM, W70-03615	07A	INDUSTRIAL WATER USAGE THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C
HYDROLOGIC INSTRUMENTS A RAINFALL RATE SENSOR, W70-03363	07B	INFILTRATION ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS, W70-03489	02A
HYDROLOGIC MODELS EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL, W70-03436	02A	HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING, W70-03493	02G
HYDROLYSIS THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF BALATHON TO THE FATHEAD MINNOW (PIMEPHALES PROTHALAS), BAFINESQUE, W70-03518	05C	INFORMATION RETRIEVAL BUILDING A COMPUTER-BASED MIS, W70-03360	10
HYDROMETRY THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN),		INFORMATION SYSTEMS BUILDING A COMPUTER-BASED MIS, W70-03360	10
		INJECTION WELLS	

INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y., W70-03249	04B	IRRIGATION CANALS HYDRAULIC CONTROLS OF WATER LEVEL, W70-03373	08C
INPUT-OUTPUT ANALYSIS ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G	IRRIGATION RETURN WATER IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B
INSECT FAUNA THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C	ISLANDS HIGHWAY TO ISLANDS IN MISSISSIPPI RIVER. W70-03538	04A
INSECTICIDES TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION, W70-03326	05C	ISRAEL ISRAEL TURNS TO SEWAGE FOR WATER. W70-03270	05D
INSTREAM AERATION AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN, W70-03625	05G	JAPAN FLOOD FORECASTING IN THE RIVER KITAKAMI, W70-03293	02A
INSTRUMENTATION A NEW RECORDING TURBIDITY METER FOR RIVERS, W70-03277	07B	CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN, W70-03316	02H
THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN), W70-03474	07A	JETS ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS, W70-03545	08B
INSURANCE CRIMINAL OFFENSES ARSON AND FRAUD, W70-03593	06E	JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY, W70-03555	08B
INTERNATIONAL HYDROLOGICAL DECADE WATER AND MAN A WORLD VIEW, W70-03450	06G	DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY' BY G. ABRAHAM, W70-03560	08B
INTERNATIONAL LAW MARITIME CONTIGUOUS ZONES, W70-03381	06E	JOINT FILLERS RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT, W70-03371	08F
INTERRENAL GLAND RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIRDNERI) TO STRESS, W70-03527	05C	JOINTS RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT, W70-03371	08F
INTERSTATE WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES), W70-03403	04A	JUDICIAL DECISIONS PIRMAN V FLORIDA STATE IMPROVEMENT COMM'N, AND STATE RD. DEP'T OF FLORIDA (BRIDGE CONSTRUCTION), W70-03300	04A
INTERSTATE COMMISSIONS DELAWARE RIVER PORT AUTHORITY (PURPOSES), W70-03573	06E	PATY V TOWN OF PALM BEACH (GROIN-ORIGINATING LAND DAMAGE), W70-03330	04A
DELAWARE RIVER PORT AUTHORITY (REVENUE), W70-03574	06E	APPEALS IN DRAINAGE AND LEVEE DISTRICT PROCEEDINGS, W70-03417	06E
INTERSTATE COMPACTS COMPACT CONCERNING PYMATUNING LAKE, W70-03411	06E	JURISDICTION CONCURRENT JURISDICTION OF THE MISSISSIPPI RIVER, W70-03600	06E
OHIO VALLEY SANITATION COMPACT, W70-03415	05G	JURISDICTION OVER BOUNDARY WATERS, W70-03601	06E
TENNESSEE RIVER BASIN POLLUTION CONTROL, W70-03420	05G	KARST KARSTIC WATER RESEARCH IN HUNGARY, W70-03264	02F
TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT, W70-03422	06B	KENTUCKY WALLACE V SCHNEIDER (SURFACE DRAINAGE), W70-03321	04A
DELAWARE RIVER PORT AUTHORITY (JOINT COMPACT WITH NEW JERSEY), W70-03572	06E	KINEMATIC WAVE THEORY FLOW ROUTING BY DIRECT INTEGRATION METHOD, W70-03294	02E
DELAWARE RIVER PORT AUTHORITY (PURPOSES), W70-03573	06E	LABORATORY TESTS X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS, W70-03286	02J
DELAWARE RIVER PORT AUTHORITY (REVENUE), W70-03574	06E	ASSESSING OUTDOOR INSULATION, W70-03368	08C
GREAT LAKES BASIN COMPACT, W70-03577	06B	LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS, W70-03451	01B
INTERSTATE COUNTY DITCHES WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES), W70-03403	04A	LAKE BEDS ARE WE LOSING OUR LAKES (STATE'S ACQUISITION OF TITLE UPON ADMISSION TO THE UNION), W70-03383	06E
IOWA ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH THEORIES TO RETAIN CONTROL OF THE LAKES), W70-03385	06E	OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES), W70-03389	06E
GRIMES V POLK COUNTY (PUBLIC RIGHTS IN PRIVATE DRAINAGE SYSTEMS), W70-03562	04A	LAKE BIWA STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM, W70-03219	02H
IRON IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO, W70-03471	02J	LAKE ERIE STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT, W70-03410	06E
IRON BACTERIA OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434	05B	PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505	05B
IRON OXIDES TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA, W70-03357	04A		

LAKE KINNERET (ISRAEL) PRESIDENT'S LECTURE	LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET, W70-03509	02B	PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H
LAKE MENDOTA (WIS) THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN, W70-03504	05B	NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA, W70-03511	05C	
LAKE MICHIGAN THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B	LAND ACQUISITION THE FEDERAL VIEW OF DAMAGES AND BENEFITS, W70-03361	06E	
LAKE MICHIGAN BEACH SURVEY 1968. W70-03339	05C	MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST, W70-03376	08C	
AUTHORITY OF CITIES TO DEVELOP SEWAGE SYSTEMS, AND TO IMPROVE LAKES AND WATERCOURSES. W70-03534	05G	LAND APPRAISAL THE FEDERAL VIEW OF DAMAGES AND BENEFITS, W70-03361	06E	
LAKE NITINAT (VANCOUVER ISLAND) DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS, W70-03503	05B	LAND DEVELOPMENT THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B	
LAKE NORRVIKEN (SWEDEN) LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET, W70-03322	02H	LAND MANAGEMENT THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B	
LAKE RENEWAL SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02B	LAND USE THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B	
LAKE SHORES THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B	LAW OF THE SEA MARITIME CONTIGUOUS ZONES, W70-03381	06E	
THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B	A UNITED STATES POLICY FOR THE WET FRONTIER, W70-03627	06E	
LAKE SUPERIOR A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02H	LEACHING POISONING THE WELLS. W70-03276	05B	
LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR, W70-03329	02H	LEAKAGE CURRENT ASSESSING OUTDOOR INSULATION, W70-03368	08C	
A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO, W70-03472	02B	LEASES STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT. W70-03410	06E	
LAKE TAHOE (CALIF) I. PRODUCTIVITY PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA, W70-03508	05C	LEGAL ASPECTS ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION- INFORMATION CENTER. W70-03379	05G	
LAKE TYPES CHIRONOMIDA AND THE STUDY OF LAKE TYPES, W70-03332	02H	WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03594	06E	
LAKES A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA, W70-03260	05C	CRIMINAL OFFENSES NUISANCES. W70-03595	06E	
FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES. W70-03307	02H	WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03596	06E	
A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02H	W70-03597	06E	
CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN, W70-03316	02H	JURISDICTION OVER BOUNDARY WATERS. W70-03601	06E	
STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM. W70-03319	02H	LEGISLATION OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABLENABILITY I), W70-03387	06E	
FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO, W70-03323	02H	OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABLENABILITY II), W70-03388	06E	
SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02B	STATE WATER POLICY COMMISSION - POWERS AND DUTIES. W70-03499	04A	
CHIRONOMIDA AND THE STUDY OF LAKE TYPES, W70-03332	02H	LEVEES LEVEE DISTRICTS. W70-03302	04A	
ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, W70-03333	02B	DRAINAGE DISTRICTS. W70-03566	04A	
BIOLOGICAL N ₂ FIXATION IN LAKES, W70-03429	05C	LEVEES. W70-03581	04A	
A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO, W70-03472	02B	DRAINAGE AND LEVEE DISTRICTS. W70-03582	04A	
THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN, W70-03504	05B	ESTABLISHMENT OF DRAINAGE AND LEVEE DISTRICTS. W70-03583	04A	
		LIBYA GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA, W70-03306	02F	
		LIGNINS POLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS, W70-03438	05G	

LIMESTONES		
SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LAUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ("SALT LAKE"), TURKEY,	02J	
W70-03446		
LIMNOLOGY		
LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR, W70-03329	02H	
PRESIDENT'S LECTURE LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNEFET, W70-03509	02H	
LOCAL GOVERNMENT		
THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B	
LOCAL GOVERNMENTS		
LEVEES. W70-03581	04A	
SUPERVISION OF LOCAL IMPROVEMENTS.	06E	
CONSTRUCTION AND MAINTENANCE OF BRIDGES. W70-03607	06E	
LOTIC ENVIRONMENT		
LABORATORY STUDIES OF PERIPHYTE PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS, W70-03327	05C	
LOUISIANA		
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA, W70-03386	06E	
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABLENITY I), W70-03387	06E	
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABLENITY II), W70-03388	06E	
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES), W70-03389	06E	
LUMBER		
DRIFTING AND FLOATING TIMBER. W70-03426	06E	
LUMBERING		
BOOM COMPANIES. W70-03412	06E	
MACROPHYTES		
FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES, W70-03307	02H	
MAGNETIC FIELDS		
MHD POWER GENERATION CURRENT STATUS, W70-03374	08C	
MAGNETOHYDRODYNAMICS		
MHD POWER GENERATION CURRENT STATUS, W70-03374	08C	
MAINE		
OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION). W70-03564	04A	
MAINTENANCE		
MUNICIPAL CORPORATIONS (PUBLIC SERVICES). W70-03579	06E	
MAINTENANCE OF PUBLIC ROADS. W70-03606	04A	
MAINTENANCE COSTS		
MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS, W70-03610	05G	
MALATHION		
UPTAKE AND RETENTION OF MALATHION BY THE CARP, W70-03516	05C	
THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATEHEAD MINNOW (PIMEPHALES PROMELAS, RAFINESQUE), W70-03518	05C	
AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C	
MANAGEMENT		
THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT, W70-03342	06F	
ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS. W70-03611	06B	
MANGANESE		
VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE EIAKE PLATEAU, W70-03462	02J	
MARINE ALGAE		
A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS, W70-03325	05C	
MARINE FISH		
EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C	
TISSUE CHANGES IN PUPPERS EXPOSED TO METHOXYPHENYL AND METHYL PARATHION, W70-03326	05C	
MARINE GEOLOGY		
RECENT SEDIMENTATION IN THE BERING SEA, W70-03500	02L	
MARKOV PROCESSES		
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E	
MATERIALS ENGINEERING		
CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372	08F	
MATERIALS TESTING		
DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354	08G	
NONDESTRUCTIVE TESTING,		
W70-03356	07B	
MATHEMATICAL MODELING		
OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS, W70-03614	05D	
MATHEMATICAL MODELS		
GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA, W70-03253	05B	
A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS, W70-03274	02F	
A NONLINEAR APPROACH TO RUNOFF STUDIES, W70-03290	02A	
AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION, W70-03291	02A	
THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION, W70-03292	02A	
FLOW ROUTING BY DIRECT INTEGRATION METHOD, W70-03294	02E	
THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS, W70-03296	02A	
A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY, W70-03301	02A	
ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G	
USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03488	05B	
HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING, W70-03493	02G	
THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE, W70-03495	02G	
SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-03496	02A	
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E	
MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS, W70-03610	05G	
MEASUREMENT		
DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354	08G	
MEDIAN TOLERANCE LIMITS		
THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES, W70-03526	05C	
MERCURY		
SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TMSAN), W70-03523	05C	
METABOLISM		
STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT		

MET-MOD

OF LAKE METABOLISM,
W70-03319

02B

SUBJECT INDEX

W70-03512

05C

LABORATORY STUDIES OF PERIPHYTON PRODUCTION AND COMMUNITY
METABOLISM IN LOTIC ENVIRONMENTS,
W70-03327

05C

MISSISSIPPI
LEVEE DISTRICTS.
W70-03302

04A

METEOROLOGICAL INSTRUMENTS
A RAINFALL RATE SENSOR,
W70-03363

07B

NAVIGABLE WATERS.
W70-03337

04A

METEOROLOGY
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS,
W70-03479

02B

WATER RESOURCES (APPROPRIATION OF WATER RESOURCES AND
RIGHTS).
W70-03635

06E

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA
AND SURINAM,
W70-03480

02B

WATER RESOURCES (BOARD OF WATER COMMISSIONERS).
W70-03636

06E

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS
IN COLOMBIA,
W70-03481

02B

WATER RESOURCES (APPLICATIONS TO APPROPRIATE).
W70-03637

06E

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR
COLOMBIA,
W70-03482

02B

MISSISSIPPI RIVER
LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE
MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,
W70-03255

02E

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL
DISTRIBUTIONS,
W70-03483

02B

HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION
OF THE GULF COASTAL PLAIN.
W70-03445

02J

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN
VENEZUELA,
W70-03484

02B

HIGHWAY TO ISLANDS IN MISSISSIPPI RIVER.
W70-03538

04A

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL,
W70-03485

02B

CONCURRENT JURISDICTION OF THE MISSISSIPPI RIVER.
W70-03600

06E

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART H. AN ANALYSIS OF THE DISTRIBUTION
OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED
STATIONS IN WESTERN COLOMBIA,
W70-03486

02B

MISSOURI
STATE HIGHWAY SYSTEM.
W70-03603

04A

METHOD OF UPTAKE
ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD
ORGANISMS,
W70-03525

05C

INUNDATED HIGHWAYS.
W70-03604

04A

METHOXYCHLOR
Tissue changes in puffers exposed to methoxychlor and methyl
parathion,
W70-03326

05C

BRIDGES AND CROSSINGS.
W70-03605

06E

METHYL PARATHION
Tissue changes in puffers exposed to methoxychlor and methyl
parathion,
W70-03326

05C

MAINTENANCE OF PUBLIC ROADS.
W70-03606

04A

MICROBIAL ECOLOGY
MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES
ON LAGOON ECOLOGY,
W70-03312

05C

CONSTRUCTION AND MAINTENANCE OF BRIDGES.
W70-03607

06E

MICROBIOLOGY
MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES
ON LAGOON ECOLOGY,
W70-03312

05C

BRIDGES (CONSTRUCTION OF BRIDGES BY COUNTY COURTS).
W70-03608

06E

MICROCLIMATOLOGY
A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND
CLEARWATER MOUNTAINS, IDAHO,
W70-03645

02B

DAMS, MILLS AND ELECTRIC POWER.
W70-03609

04A

MICROCYSTIS AERUGINOSA(KUTZ)
THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,
W70-03507

05C

MISSOURI RIVER
LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE
MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,
W70-03255

02E

MICROFLORA
PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO
AQUATIC MICROFLORA,
W70-03505

05B

MIXING
THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR,
W70-03542

05D

MICROMETEOROLOGY
A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND
CLEARWATER MOUNTAINS, IDAHO,
W70-03645

02B

DISCUSSION OF "TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS"
BY R. FRANKEL AND J. CUMMING,
W70-03553

08B

MILLDAMS
REMOVAL OF MILLDAMS.
W70-03576

06E

OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,
W70-03614

05D

MICROCLIMATOLOGY
HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION
OF THE GULF COASTAL PLAIN,
W70-03445

02J

MODEL STUDIES
THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR
HYDROLOGIC SYSTEMS INVESTIGATION,
W70-03292

02A

MINNESOTA
GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL
MINNESOTA,
W70-03477

02F

FLOOD FORECASTING IN THE RIVER KITAKAMI,
W70-03293

02A

THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH
PROJECT.

THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC
TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,
W70-03296

02A

SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA,
W70-03297

02F

THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL,
W70-03475

02E

THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW,
W70-03492

02A

HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING,
W70-03493

02G

THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR,
W70-03542

05D

STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR,
W70-03543

08B

MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES,
W70-03544

08B

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,
W70-03549

05B

JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH
THEORY,
W70-03555

08B

MONITORING OFFSITE RADICOLICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968, W70-03452	05A	PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311 02H
MONTANA FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA. W70-03272	04A	NETS CONSERVATION OF NATURAL RESOURCES (FISHING). W70-03407 06E
SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA, W70-03457	02J	NEUTRON ACTIVATION ANALYSIS NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351 05A
MOSQUITOES HEALTH AND SAFETY (MALARIA). W70-03591	06E	NEW JERSEY DIVISION OF WATER DEVELOPMENT. W70-03491 03B
MULTIPLE USE MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST, W70-03376	08C	STATE WATER POLICY COMMISSION - POWERS AND DUTIES. W70-03499 04A
MULTIPLE-PURPOSE RESERVOIRS COMPACT CONCERNING PYMATUNING LAKE. W70-03411	06E	W70-03514 04A
MUNICIPAL WASTES PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL. W70-03439	05G	PAYMENTS TO STATE FOR WATERS DIVERTED. W70-03517 06D
WATERWORKS AND SEWERAGE. W70-03535	05G	NEW YORK FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK. W70-03261 04A
MUNICIPAL WATER PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL. W70-03439	05G	NITRATE THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (IN GERMAN), W70-03318 02H
NATAL A NEW RECORDING TURBIDITY METER FOR RIVERS, W70-03277	07B	NITRATES POISONING THE WELLS. W70-03276 05B
NATIONAL FORESTS W70-03598	06E	EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334 05D
NATURAL DRAINS DRAINAGE (CONTROL OF WATER ON THE SURFACE ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS). W70-03633	04A	NITRITES THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (IN GERMAN), W70-03318 02H
NATURAL RECHARGE ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS, W70-03489	02A	NITROGEN THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (IN GERMAN), W70-03318 02H
NATURAL RESOURCES INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES. W70-03348	06B	BIOLOGICAL N2 FIXATION IN LAKES, W70-03429 05C
DIVISION OF WILDLIFE. W70-03588	06E	NITROGEN FIXATION NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA, W70-03511 05C
NAVIGABLE RIVERS NAVIGABLE WATERS. W70-03337	04A	NITROGEN-FIXATION BIOLOGICAL N2 FIXATION IN LAKES, W70-03429 05C
NAVIGABLE WATERS PENN CENTRAL CO V BUCKLEY AND CO, INC (RAILROAD DENIED INJUNCTIVE RELIEF). W70-03298	04A	NON-DESTRUCTIVE TESTS NONDESTRUCTIVE TESTING, W70-03356 07B
NAVIGABLE WATERS. W70-03337	04A	NON-NAVIGABLE WATERS OBSTRUCTIONS IN NON-NAVIGABLE WATERS. W70-03536 04A
PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS, W70-03380	06E	NON-STRUCTURAL ALTERNATIVES EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA), W70-03458 02E
WATERS, WATERWAYS, DRAINS AND LEVEES (WATERCOURSES). W70-03413	04A	NORRIS RESERVOIR WATER TEMPERATURE AND SPRING FISHING, NORRIS RESERVOIR, TENNESSEE, W70-03559 05C
LANDING AND LOADING FACILITIES. W70-03414	06E	NORTH DAKOTA ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH TREATRIES TO RETAIN CONTROL OF THE LAKES), W70-03385 06E
PUBLIC UTILITIES AND CARRIERS. W70-03586	06E	NUCELLA LAPILLUS THE EFFECTS OF OIL-SPILL REMOVERS ("DETERGENTS") ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513 05C
NAVIGATION CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS). W70-03406	04A	NUCLEAR EXCAVATION NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362 08H
WATERCRAFT NAVIGATION. W70-03408	06E	NUCLEAR EXPLOSIONS NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362 08H
BOOM COMPANIES. W70-03412	06E	VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370 08D
WATERS, WATERWAYS, DRAINS AND LEVEES (WATERCOURSES). W70-03413	04A	MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN
TELEGRAPH AND TELEPHONES. W70-03427	06E	
BRIDGE COMPANIES (CONSTRUCTION OF BRIDGES AND INTERFERENCE WITH NAVIGATION). W70-03589	06E	
NET PLANKTON A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET		

SURROUNDING AQUIFERS.	08H	W70-03405	04D
OFFSITE RADICLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968,	05A	W70-03406	CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS) - 04A
W70-03452		W70-03407	CONSERVATION OF NATURAL RESOURCES (FISHING) - 06E
NUTRIENT REQUIREMENTS ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE,	05C	W70-03408	WATERCRAFT NAVIGATION. 06E
W70-03335		W70-03409	BRIDGE COMPANIES. 06E
THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,	05C	W70-03410	STATE'S POWER OVER WATERS OF LAKE EBIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT. 06E
W70-03507		W70-03411	COMPACT CONCERNING PYMATUNING LAKE. 06E
NUTRIENTS BIOLOGICAL N2 FIXATION IN LAKES.	05C	W70-03575	WATER DEVELOPMENT AUTHORITY. 06B
W70-03429		W70-03576	REMOVAL OF MILLDAMS. 06E
THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,	05C	W70-03577	GREAT LAKES BASIN COMPACT. 06B
W70-03507		W70-03578	SOIL AND WATER CONSERVATION COMMISSION. 06B
OAHU(HAWAII) SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII,	02A	W70-03579	MUNICIPAL CORPORATIONS (PUBLIC SERVICES). 06E
W70-03613		W70-03580	CONTROL AND IMPROVEMENT OF NATURAL WATERCOURSES. 04A
OAKS (PENN)		W70-03588	DIVISION OF WILDLIFE. 06E
EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA).	02E	W70-03643	WATER SUPPLY - SANITATION - DITCHES (ORGANIZATION AND PURPOSES OF CONSERVANCY DISTRICTS). 04A
W70-03458		W70-03644	CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION). 05G
OBSERVATION WELLS RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS,	02F	W70-03255	OHIO RIVER LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES. 02E
W70-03459		W70-03409	BRIDGE COMPANIES. 06E
OBSTRUCTION TO FLOW OBSTRUCTIONS IN NON-NAVIGABLE WATERS.	04A	W70-03415	OHIO VALLEY SANITATION COMPACT. 05G
W70-03536		W70-03349	OIL WASTES CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS. 05C
PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES).	04A	W70-03425	OIL WELLS OIL AND GAS. 08G
W70-03592		W70-03513	OILY WATER THE EFFECTS OF OIL-SPILL REMOVERS ("DETERGENTS") ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY. 05C
CRIMINAL OFFENSES NUISANCES.	06E	W70-03248	OPEN CHANNEL FLOW UNIVERSAL FORMULA FOR UNIFORM FLOW. 08B
W70-03595		W70-03342	OPEN SPACE THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT. 06F
OCEAN CURRENTS NEPHROPOD LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN,	02L	W70-03610	OPERATING COSTS MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS. 05G
W70-03463		W70-03463	OPTICAL PROPERTIES NEPHROPOD LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN. 02L
OCEANS MARITIME CONTIGUOUS ZONES,	06E	W70-03614	OPTIMIZATION OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS. 05D
W70-03381		W70-03547	ORGANIC LOADING EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS. 05C
VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE BLAKE PLATEAU,	02J	W70-03399	ORGANIC MATTER FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD-WATER LAKES. 02H
W70-03462		W70-03401	DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS. 02H
OCHRATOXIN A THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, ARTEMIA SALINA,	05C	W70-03402	
W70-03528		W70-03403	
ODOR HYDROGEN SULFIDE ODOR THRESHOLD,	05A	W70-03404	
W70-03275		W70-03405	
RESEARCH ON TASTES AND ODORS,	05F	W70-03406	
W70-03440		W70-03407	
OHIO CONSERVANCY DISTRICTS (WATERCOURSES, WATER RIGHTS AND USES, AND CONSTRUCTION AND MAINTENANCE OF RECREATIONAL FACILITIES).	04A	W70-03408	
W70-03395		W70-03409	
COUNTY WATER SUPPLY SYSTEMS.	04A	W70-03410	
W70-03396		W70-03411	
WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS).	03D	W70-03412	
W70-03397		W70-03413	
POWERS OF THE WATER POLLUTION CONTROL BOARD.	05G	W70-03414	
W70-03398		W70-03415	
THE ORGANIZATION, PURPOSES, AND POWERS OF A SANITARY DISTRICT.	05G	W70-03416	
W70-03399		W70-03417	
DUTIES OF SANITARY DISTRICTS REGARDING POLLUTION, WATER SUPPLY, MOSQUITO CONTROL, AND INVESTIGATIONS OF RAINFALL AND STREAMFLOW.	05G	W70-03418	
W70-03400		W70-03419	
WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS).	04A	W70-03420	
W70-03401		W70-03421	
WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS).	04A	W70-03422	
W70-03402		W70-03423	
WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES).	04A	W70-03424	
W70-03403		W70-03425	
WATER SUPPLY--SANITATION--DITCHES.	04A	W70-03426	
W70-03404		W70-03427	
CONSERVATION OF NATURAL RESOURCES (SHORE EROSION).		W70-03428	

SUBJECT INDEX

ORG-PES

W70-03503	05B	PENALTIES (CIVIL) PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES). W70-03592	04A
ORGANIZATIONAL ARRANGEMENTS ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS. W70-03611	06B	PENALTIES (CRIMINAL) HEALTH WATER, SEWAGE, GARBAGE. W70-03629	05F
ORGANIC-PHOSPHORUS PESTICIDES SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES. W70-03623	05C	HEALTH WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE). W70-03630	05F
ORIFICES MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	08B	PENNSYLVANIA EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA), W70-03458	02E
OUTLETS JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY, W70-03555	08B	VACATION OR RELOCATION OF WATERCOURSES - CONSTRUCTION OF DAMS. W70-03521	04A
OVERLAND FLOW THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL, W70-03475	02E	FLOOD CONTROL. W70-03529	04A
THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW, W70-03492	02A	ACQUISITION OF LAND TO PREVENT CONTAMINATION. W70-03532	05G
OWNERSHIP OF BEDS ARE WE LOSING OUR LAKES, W70-03382	06E	BRIDGES AND VIADUCTS. W70-03533	04A
ARE WE LOSING OUR LAKES (STATE'S ACQUISITION OF TITLE UPON ADMISSION TO THE UNION), W70-03383	06E	WHARVES, DOCKS AND FERRIES. W70-03570	06E
ARE WE LOSING OUR LAKES. (STATE'S ACQUISITION OF TITLE THROUGH CONSTRUCTION OF FEDERAL PATENTS ACCORDING TO LOCAL LAW), W70-03384	06E	TURNEPIKE BRIDGE ACROSS THE DELAWARE RIVER. W70-03571	06E
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA, W70-03386	06E	DELAWARE RIVER PORT AUTHORITY (JOINT COMPACT WITH NEW JERSEY). W70-03572	06E
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY I), W70-03387	06E	DELAWARE RIVER PORT AUTHORITY (PURPOSES). W70-03573	06E
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY II), W70-03388	06E	DELAWARE RIVER PORT AUTHORITY (REVENUE). W70-03574	06E
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES), W70-03389	06E	SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES. W70-03639	06E
OXYGENATION OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434	05B	PERIPHERYTON LABORATORY STUDIES OF PERIPHERYTON PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS. W70-03327	05C
OXYGEN AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN, W70-03625	05G	PERKIOMEN CREEK EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA), W70-03458	02E
OXYGENATION DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS, W70-03503	05B	PERMEABLE BEDS THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J
PALaeHYDROLOGY PALEOHYDROLOGY APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST, W70-03490	02A	PERMITS COUNTY WATER SUPPLY SYSTEMS. W70-03396	04A
PARENT STREAM THEORY THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER, W70-03546	05C	SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES. W70-03639	06E
PARS THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT., W70-03342	06F	DAMS AND BRIDGES (PROCEDURES REGARDING WATER POWER PERMITS). W70-03640	06E
PARTICLE SHAPE AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J	PUBLIC DOMAIN AND TRUST FUNDS (DAMS AND BRIDGES). W70-03641	06E
PARTICLE SIZE PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING, W70-03287	02J	PESTICIDE KINETICS POSSIBILITIES FOR MINERALIZATION OF PESTICIDES (DUTCH), W70-03271	05G
PARTICULATE FRACTIONS PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505	05B	PESTICIDE MONITORING A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B
PASSAGE OF WATER REMOVAL OF MILLDAMS. W70-03576	06E	PESTICIDE REMOVAL BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C
PEAK POWER ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND FUTURE DEVELOPMENT OF GRAND COULEE DAM, W70-03358	08C	ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS, W70-03525	05C
PENALTIES (CIVIL) PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES). W70-03592		PESTICIDE RESIDUES POSSIBILITIES FOR MINERALIZATION OF PESTICIDES (DUTCH), W70-03271	05G
PENNSYLVANIA EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA), W70-03458		A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B
PENULTIMATE FRACTIONS PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505		UPTAKE AND RETENTION OF MALATHION BY THE CARP, W70-03516	05C
PENULTIMATE FRACTIONS PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505		ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS, W70-03525	05C
PESTICIDE TOXICITY REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SUBLETHAL CONCENTRATIONS OF DDT,		PESTICIDE TOXICITY REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SUBLETHAL CONCENTRATIONS OF DDT,	05C

SUBJECT INDEX

W70-03515	05C	PLOWSHARE OPERATION NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362	08H
BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C		
THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES, W70-03526	05C	POLARIZATION POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND, W70-03365	08G
PESTICIDES A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	POLLUTANT IDENTIFICATION THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN, W70-03504	05B
A NEW POLLUTION PROBLEM, W70-03456	05B	POLLUTION ABATEMENT PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES, W70-03345	05G
PETROFABRICS AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J	CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION. W70-03364	05G
DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES, W70-03285	02J	POLLUTION CONTROL CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION. W70-03364	05G
PHENOXY ACETATES A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	POLYMER CONCRETES CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372	08F
PHOSPHATES A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES, W70-03346	05D	POLYMERS CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372	08F
EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE, W70-03612	05D	POOROUS MEDIA SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA, W70-03297	02F
PHOSPHORUS THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (IN GERMAN), W70-03318	02H	THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE, W70-03495	02G
MEASUREMENT OF PHOSPHORUS IN WASTEWATER, W70-03331	05A	PORT AUTHORITIES DELAWARE RIVER PORT AUTHORITY (JOINT COMPACT WITH NEW JERSEY), W70-03572	06E
PHOTOSYNTHESIS FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES, W70-03307	02H	POTABLE WATER LEGAL VIEWPOINT (WATER STANDARDS), W70-03561	05G
THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION, W70-03313	02K	POTATOES CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT, W70-03433	05D
PHYSIOLOGICAL ECOLOGY PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROTROPHY IN ALgal FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS, W70-03336	05C	PRECIPITATION(ATMOSPHERIC) GENERALIZING DRY-DAY FREQUENCY DATA, W70-03441	02B
PHYTOPLANKTON SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02H	VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA, W70-03461	02C
PIEDMONT EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL, W70-03436	02A	A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO, W70-03645	02B
PIERS WHARVES, DOCKS AND FERRIES, W70-03570	06E	PRESERVES GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION), W70-03590	06E
PLANNING THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B	PRIMARY PRODUCTIVITY ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM, W70-03309	05C
MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL, W70-03343	04C	A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NEt PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02H
ARROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING, W70-03465	06G	THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION, W70-03313	02K
THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B	SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02B
PLASMA CORTISOL RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIRDNERI) TO STRESS, W70-03527	05C	PRIOR APPROPRIATION WATER RESOURCES (APPROPRIATION OF WATER RESOURCES AND RIGHTS), W70-03635	06E
PLASMA GLUCOSE RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIRDNERI) TO STRESS, W70-03527	05C	PRIVIES HEALTH WATER, SEWAGE, GARBAGE, W70-03629	05F
PLASTICS CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372	08F	PROBABILITY GENERALIZING DRY-DAY FREQUENCY DATA, W70-03441	02B
PLAYAS SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACOSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ('SALT LAKE'), TURKEY, W70-03446	02J	SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-03496	02A
		RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT, W70-03498	04A
		PROCESS WATER COST HANDBOOK FOR INDUSTRIAL WATER USES, W70-03432	06C

PRODUCTIVITY		PYRITE
LABORATORY STUDIES OF PERIPHYTON PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS,	W70-03327	OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434
	05C	05B
PROFILES		QUALITY CONTROL
LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,	W70-03255	RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT, W70-03371
	02E	08F
PROJECT PLANNING		STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543
PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES.	W70-03345	08B
	05G	WEATHERING AND ROUNDNESS OF QUARTZ SAND GRAINS, W70-03283
PROJECTS		02J
ARROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING,	W70-03465	RADIATION
	06C	ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308
PROPERTY VALUES		07B
THE FEDERAL VIEW OF DAMAGES AND BENEFITS,	W70-03361	RADIOACTIVITY
	06E	ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308
PROVENANCE		07B
HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN,	W70-03445	OFFSITE RADIOLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968, W70-03452
	02J	05A
PUBLIC HEALTH		RADIOECOLOGY
STUDIES RELATING TO WATER MINERALIZATION AND HEALTH,	W70-03252	ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308
	05C	07B
WATERWORKS AND SEWERAGE.	W70-03535	RADIOISOTOPES
	05G	ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308
LEGAL VIEWPOINT (WATER STANDARDS),	W70-03561	07B
	05G	RAILROADS
HEALTH AND SAFETY (MALARIA).	W70-03591	PENN CENTRAL CO V BUCKLEY AND CO, INC (RAILROAD DENIED INJUNCTIVE RELIEF). W70-03298
	06E	04A
PUBLIC RIGHTS		RAIN GAGES
ARE WE LOSING OUR LAKES,	W70-03382	A RAINFALL RATE SENSOR, W70-03363
	06E	07B
PUBLIC SERVICES		RAINBOW TROUT
MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST,	W70-03376	SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN), W70-03523
	08C	05C
PUBLIC UTILITIES		AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDRONERII RICHARDSON, W70-03554
MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST,	W70-03376	05C
	08C	RAINFALL
OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION).	W70-03564	A RAINFALL RATE SENSOR, W70-03363
	04A	07B
MUNICIPAL CORPORATIONS (PUBLIC SERVICES).	W70-03579	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS, W70-03479
	06E	02B
PUBLIC UTILITIES AND CARRIERS.	W70-03586	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURIRAM, W70-03480
	06E	02B
WATER AND WATERWORKS COMPANIES.	W70-03587	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA, W70-03481
	06E	02B
PUERTO RICO		RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA, W70-03482
THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION,	W70-03245	02B
	06B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS, W70-03483
	04A	02B
THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,	W70-03246	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA, W70-03484
	04A	02B
DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES,	W70-03247	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL, W70-03485
	06D	02B
PUFFERS		RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART H. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03486
TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION.	W70-03326	02B
	05C	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART I. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03487
PULP WASTES		02B
POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS,	W70-03438	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART J. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03488
	05G	02B
PULPING WASTES		RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART K. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03489
FOAM SEPARATION OF KRAFT PULPING WASTES.	W70-03350	02B
	05D	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART L. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03490
PUMPED STORAGE		02B
SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,	W70-03244	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART M. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03491
	05C	02B
FISH AND POWER PLANTS,	W70-03250	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART N. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03492
	05C	02B
PURIFICATION WORKS		RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART O. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03493
CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION).	W70-03644	02B
	05G	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART P. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03494
PYMATUNING LAKE		02B
COMPACT CONCERNING PYMATUNING LAKE.	W70-03411	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART Q. ANOTHER ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03495
	06E	02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM, W70-03480	02B	RECREATION FACILITIES LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR). W70-03391	06B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA, W70-03481	02B	LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE). W70-03392	06B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA, W70-03482	02B	RECREATIONAL FACILITIES LAND AND WATER CONSERVATION ACT (DEPARTMENTS OF COMMERCE AND DEFENSE). W70-03393	06B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS, W70-03483	02B	LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS). W70-03394	06B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA, W70-03484	02B	REFUGE HARBORS WATERCRAFT NAVIGATION. W70-03408	06B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL, W70-03485	02B	REGULATION LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT, W70-03341	06F
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART G. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03486	02B	WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03597	06E
RAINFALL-RUNOFF RELATIONSHIPS A NONLINEAR APPROACH TO RUNOFF STUDIES, W70-03290	02A	WATER SUPPLY - SANITATION - DITCHES (ORGANIZATION AND PURPOSES OF CONSERVANCY DISTRICTS). W70-03643	08A
AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION, W70-03291	02A	REGULATORY BIOLOGY PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROCHROPHY IN ALGAL FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS, W70-03336	05C
THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION, W70-03292	02A	REINFORCING THE PRINCIPLE OF REINFORCED EARTH, W70-03359	08D
FLOOD FORECASTING IN THE RIVER KITAKAMI, W70-03293	02A	REINFORCEMENT THE PRINCIPLE OF REINFORCED EARTH, W70-03359	08D
FLOW ROUTING BY DIRECT INTEGRATION METHOD, W70-03294	02E	RELOCATION THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER, W70-03546	05C
COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION, W70-03295	02E	RESERVATION DOCTRINE ARE WE LOSING OUR LAKES, W70-03382	06E
THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS, W70-03296	02A	ARE WE LOSING OUR LAKES (STATE'S ACQUISITION OF TITLE UPON ADMISSION TO THE UNION), W70-03383	06E
A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES, W70-03305	02A	ARE WE LOSING OUR LAKES. (STATE'S ACQUISITION OF TITLE THROUGH CONSTRUCTION OF FEDERAL PATENTS ACCORDING TO LOCAL LAW), W70-03384	06E
HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, BRAZOS RIVER BASIN, TEXAS, 1955-64, W70-03467	02E	RESERVOIR FISHERIES THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN US RESERVOIRS, W70-03324	02H
THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL, W70-03475	02E	RESERVOIR OPERATION RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT, W70-03498	08A
THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW, W70-03492	02A	RESERVOIR OWNERS THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B
RAPID EXCAVATION NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362	08H	RESERVOIR YIELD RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT, W70-03498	08A
RASBORA HETEROMORPHA (BARLEQUIN) SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C	RESERVOIRS WATER RESERVOIR SYSTEMS. W70-03435	08A
RECHARGE WELLS INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y., W70-03249	04B	DIVISION OF WATER DEVELOPMENT. W70-03491	03B
RECLAIMED WATER OPPORTUNITIES FOR WATER SALVAGE, W70-03251	05D	COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (IN RUSSIAN), W70-03539	05C
RECOVERY THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C	HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAPY RESERVOIR (1958-1960), W70-03541	02H
RECREATION THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B	THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D
CONSERVATION OF NATURAL RESOURCES (FISHING). W70-03407	06E	THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B
COMPACT CONCERNING PYMATUNING LAKE. W70-03411	06E	RESIDUE DISTRIBUTION UPTAKE AND RETENTION OF MALATHION BY THE CARP, W70-03516	05C
THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B		

RESOURCE ALLOCATION AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, W70-03619	05G	SYSTEMS). W70-03562	04A
RETENTION UPTAKE AND RETENTION OF MALATHION BY THE CARP, W70-03516	05C	ROADS SUPERVISION OF LOCAL IMPROVEMENTS. W70-03602	06E
RETURN FLOW IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B	STATE HIGHWAY SYSTEM. W70-03603	04A
REVIEWS WATER AND MAN A WORLD VIEW, W70-03450	06G	ROOT EFFECT SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C
ARROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING, W70-03465	06G	ROOT ZONES ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
RHODE ISLAND FISH TRAPS LICENSING AND REGULATION. W70-03638	06E	ROOTING PATTERNS ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
RIGHT-OF-WAY MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST, W70-03376	08C	ROtenone THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C
RIPARIAN LAND STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT. W70-03410	06E	ROUGHNESS(HYDRAULIC) STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE, W70-03620	08B
RIPARIAN RIGHTS PIRMAN V FLORIDA STATE IMPROVEMENT COMM'N, AND STATE RD. DEPT' OF FLORIDA (BRIDGE CONSTRUCTION). W70-03300	04A	ROUTING AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION, W70-03291	02A
PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS, W70-03380	06E	FLOW ROUTING BY DIRECT INTEGRATION METHOD, W70-03294	02E
ARE WE LOSING OUR LAKES, W70-03382	06E	THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL, W70-03475	02E
ARE WE LOSING OUR LAKES. (STATE'S ACQUISITION OF TITLE THROUGH CONSTRUCTION OF FEDERAL PATENTS ACCORDING TO LOCAL LAW), W70-03384	06E	RUNOFF PALEOHYDROLOGY APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST, W70-03490	02A
AUTHORITY OF CITIES TO DEVELOP SEWAGE SYSTEMS, AND TO IMPROVE LAKES AND WATERCOURSES. W70-03534	05G	CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDEAO, RUNOFF FLOWAGE, W70-03501	05B
DUVAL ENGINEERING AND CONTRACTING CO V SALES (RIPARIAN RIGHTS). W70-03563	06E	ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
LAND FOR INSTITUTIONAL WATER OR SEWAGE SYSTEM. W70-03599	06E	RUNOFF FORECASTING A NONLINEAR APPROACH TO RUNOFF STUDIES, W70-03290	02A
RIPLLE MARKS INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE, W70-03284	02L	THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS, W70-03296	02A
INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER-POINTBAR DEPOSITS, LOWER RHINE), W70-03289	02J	RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING, W70-03304	02A
RISKS SOCIAL BENEFIT VERSUS TECHNOLOGICAL RISK, W70-03377	06B	SAFETY BOATING SAFETY ACT OF 1965. W70-03423	06E
RIVER BASIN DEVELOPMENT OHIO VALLEY SANITATION COMPACT. W70-03415	05G	SALINE WATER SURFACE PROPERTIES OF TEFLO FILM IN SALINE WATER PROCESSES, W70-03646	03A
TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT. W70-03422	06B	SALINITY EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER, W70-03464	02C
RIVER BASINS REPORT OF COMMITTEE ON POLLUTION. W70-03378	05G	SAMPLING A NEW RECORDING TURBIDITY METER FOR RIVERS, W70-03277	07B
ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS. W70-03611	06B	PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H
RIVER BEDS STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE, W70-03620	08B	SAND FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D
RIVERS OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA, W70-03386	06E	SAND WAVES INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER-POINTBAR DEPOSITS, LOWER RHINE), W70-03289	02J
PALEOHYDROLOGY APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST, W70-03490	02A	SANDS WFATHERING AND ROUNDNESS OF QUARTZ SAND GRAINS, W70-03283	02J
ROAD CONSTRUCTION HIGHWAY TO ISLANDS IN MISSISSIPPI RIVER. W70-03538	04A	GEOLGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L
GRIMES V POLK COUNTY (PUBLIC RIGHTS IN PRIVATE DRAINAGE			

SUBJECT INDEX

SAN-SHO	
SANITARY DISTRICT WATERWORKS AND SEWERAGE. W70-03535	05G
SANITARY ENGINEERING POWERS OF THE WATER POLLUTION CONTROL BOARD. W70-03398	05G
SCALING SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES, W70-03646	03A
SCENEDESMUS EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D
SCOURING WASTE AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY. W70-03531	05D
SEA WATER LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS. W70-03451	01B
EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER. W70-03464	02C
SEAS MARITIME CONTIGUOUS ZONES. W70-03381	06E
SEASONAL STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM. W70-03319	02H
SEDIMENT TRANSPORT SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA. W70-03457	02J
THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J
SEDIMENTARY PETROLOGY X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS, W70-03286	02J
HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN, W70-03445	02J
GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L
SEDIMENTARY STRUCTURES INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE INFOSHORE ZONE, W70-03284	02L
INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER- FOOTBAR DEPOSITS, LOWER RHINE). W70-03289	02J
SEDIMENTATION STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM. W70-03319	02H
RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES, W70-03478	02L
PALEOHYDROLOGY APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST. W70-03490	02A
RECENT SEDIMENTATION IN THE BERING SEA, W70-03500	02L
SEDIMENTS OCCURRENCE AND SIGNIFICANCE OF IRON, MANGANESE, AND TITANIUM IN GLACIAL MARINE SEDIMENTS FROM THE ESTUARY OF THE ST LAURENCE RIVER, W70-03320	02K
CONSOLIDATION AND SEDIMENTATION-COMPRESION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448	02E
THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS. W70-03468	02K
GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L
A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS, W70-03470	07B
IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO, W70-03471	02J
A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE	
SUPERIOR, ONTARIO, W70-03472	02H
CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE, W70-03501	05E
SEDIMENT-WATER INTERFACES THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J
SEEPAGE THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J
SELF-PURIFICATION EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF- PURIFICATION OF WATERS, W70-03547	05C
SENSITIVITY INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621	05C
SENSITIVITY ANALYSIS USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03468	05E
SEPTIC TANKS HEALTH WATER, SEWAGE, GARBAGE. W70-03629	05F
HEALTH WATER, SEWAGE, GARBAGE (PRIVIES, SEWAGE SYSTEMS, SEPTIC TANKS). W70-03631	05F
HEALTH WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY). W70-03632	05F
SESTON CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE, W70-03501	05B
SEVIN AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C
SEWAGE MEASUREMENT OF PHOSPHORUS IN WASTEWATER, W70-03331	05A
HEALTH WATER, SEWAGE, GARBAGE. W70-03629	05F
SEWAGE DISPOSAL WATERWORKS AND SEWERAGE. W70-03535	05G
HEALTH WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY). W70-03632	05F
SEWAGE DISTRICTS OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION). W70-03564	04A
SEWAGE LAGOONS MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES ON LAGOON ECOLOGY. W70-03312	05C
SEWAGE SLUDGE MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS. W70-03610	05G
SEWAGE TREATED EFFLUENT FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D
SEWERS JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY, W70-03555	08B
SHAD FISHING SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES. W70-03639	06E
SHAGAWA LAKE(MINN) THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT, W70-03512	05C
SHEEPSHEAD MINNOWS INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621	05C
SHELL GROWTH THE EFFECTS OF OIL-SPILL REMOVERS ('DETERGENTS') ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513	05C
SHOCK WAVES VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR	

W70-03370	08D	
SHORE PROTECTION CONSERVATION OF NATURAL RESOURCES (SHORE EROSION). W70-03405	04D	
STEVE ANALYSIS PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING, W70-03287	02J	
SIMULATED RAINFALL THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW, W70-03492	02A	
SIMULATION EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL, W70-03436	02A	
SIMULATION ANALYSIS SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA, W70-03297	02F	
SLOPE STABILITY THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J	
SLUICFS PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES). W70-03592	04A	
SLUICEWAY PUBLIC UTILITIES AND CARRIERS. W70-03586	06E	
SMALL WATERSHEDS HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, BRAZOS RIVER BASIN, TEXAS, 1955-64, W70-03467	02E	
SNAKE RIVER CANYON (IDAHO) A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO, W70-03645	02B	
SOCIAL NEEDS PRESIDENT'S LECTURE LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET, W70-03509	02H	
SOCIAL VALUES SOCIAL BENEFIT VERSUS TECHNOLOGICAL RISK, W70-03377	06B	
SOIL STRENGTH CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448	08E	
SOLAR RADIATION HYDROMINNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551	05A	
SOUTH CAROLINA QUALITY OF SURFACE WATERS OF SOUTH CAROLINA A SUMMARY OF DATA, 1945-1968, W70-03266	05B	
HEALTH WATER, SEWAGE, GARBAGE. W70-03629	05F	
HEALTH WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE). W70-03630	05F	
HEALTH WATER, SEWAGE, GARBAGE (PRIVIES, SEWAGE SYSTEMS, SEPTIC TANKS). W70-03631	05F	
HEALTH WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY). W70-03632	05F	
SOUTH DAKOTA ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH THEORIES TO RETAIN CONTROL OF THE LAKES), W70-03385	06B	
SPECIES COMPOSITION SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02H	
SPECIFICATIONS DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354	08G	
ST LAWRENCE RIVER COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES, W70-03315	02H	
STANFORD WATERSHED MODEL EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL, W70-03436	02A	
STATE GOVERNMENTS PAYMENTS TO STATE FOR WATERS DIVERTED. W70-03517	06D	
STATISTICAL METHODS COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY, W70-03256	07C	
REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263	07C	
PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING, W70-03287	02J	
VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS, W70-03303	07C	
RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING, W70-03304	02A	
A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES, W70-03305	02A	
DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354	08G	
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E	
RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT, W70-03498	04A	
STOMEBOATS PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES). W70-03592	04A	
STEP AERATION OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS, W70-03614	0SD	
STOCHASTIC PROCESSES A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY, W70-03301	02A	
SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-03496	02A	
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E	
STORM DRAINS COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION, W70-03295	02E	
STRAIN MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, W70-03455	02G	
STRAIN MEASUREMENT MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, W70-03455	02G	
STRATIFICATION STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543	08B	
DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN CUTFALLS' BY R. FRANKEL AND J. CUMMING, W70-03553	08B	
DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER MEDIA' BY G. ABRAHAM, W70-03560	08B	
STRATIFIED FLOW MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	08B	
STREAM GAGES MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS, W70-03280	02E	
STREAM LENGTH RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES, W70-03487	02E	
STREAMFLOW REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263	07C	
MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS, W70-03280	02E	
STREAMFLOW FORECASTING AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION, W70-03291	02A	
VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS, W70-03303	07C	
RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING, W70-03304	02A	

SUBJECT INDEX

STR-TEN	
A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES, W70-03305	02A
RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES, W70-03487	02E
STIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-03496	02A
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E
RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT, W70-03498	04A
STREAMS ROOM COMPANIES. W70-03412	06E
OBSTRUCTIONS IN NON-NAVIGABLE WATERS. W70-03536	04A
STREAM-BEDS THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J
STRESS RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (<i>SMOLIUS GARDNERI</i>) TO STRESS, W70-03527	05C
STRIP MINE WASTES DETERMINING PH OF STRIP-MINE SPOILS, W70-03281	05A
STRUCTURES WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03597	06E
SUBLETHAL EFFECTS REPRODUCTION IN BROOK TROUT (<i>SMELTINUS FONTINALIS</i>) Fed SUBLETHAL CONCENTRATIONS OF DDT, W70-03515	05C
SUBSURFACE WATERS EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D
SULFUR DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS, W70-03502	05A
SURFACE EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D
SURFACE DRAINAGE WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS). W70-03402	04A
DRAINAGE (CONTROL OF WATER ON THE SURFACE ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS). W70-03633	04A
SURFACE RUNOFF GRIEVES V POLK COUNTY (PUBLIC RIGHTS IN PRIVATE DRAINAGE SYSTEMS). W70-03562	04A
SURFACE WATERS MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278	02E
SURFACE-GROUNDWATER RELATIONSHIPS BASE-FLOW STUDIES OF LIPON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1960, W70-03466	02E
ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS, W70-03489	02A
HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING, W70-03493	02G
SURFACTANTS BIODEGRADABLE DETERGENTS RECENT PROBLEMS AND PROGRESS. W70-03530	05D
SURINAM RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS, W70-03483	02B
SURVEYS ARROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING, W70-03465	06G
SUSCEPTIBILITY SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETYL MERCURY PHOSPHATE FORMULATION	
(TIMSAN), W70-03523	05C
THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES, W70-03526	05C
SYNERGISM THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (<i>PIMEPHALES PROMELAS</i> , RAFINESQUE), W70-03518	05C
SYNOPTIC ANALYSIS RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM, W70-03480	02B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA, W70-03481	02B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA, W70-03482	02B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS, W70-03483	02B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA, W70-03484	02B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL, W70-03485	02B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART H. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03486	02B
SYNTHETIC HYDROLOGY THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIONUCLIDES AEROSOLS, W70-03296	02A
SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA, W70-03297	02F
SYSTEMS ANALYSIS ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G
TASTE RESEARCH ON TASTES AND ODORS, W70-03440	05P
TAX RATE DRAINAGE DISTRICTS (TAXATION). W70-03569	04A
TAXES DRAINAGE DISTRICTS (TAXATION). W70-03569	04A
TEMPERATURE HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAPY RESERVOIR (1958-1960), W70-03541	02H
EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRATE AND FIN BAYS IN YOUNG CHINOOK SALMON, W70-03557	05C
WATER TEMPERATURE AND SPRING FISHING, MORRIS RESERVOIR, TENNESSEE, W70-03559	05C
TEMPERATURE GRADIENT TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT, W70-03556	05C
TENNESSEE BOOM COMPANIES. W70-03412	06E
WATERS, WATERWAYS, DRAINS AND LEVEES (WATERCOURSES). W70-03413	04A
LANDING AND LOADING FACILITIES. W70-03414	06E
OHIO VALLEY SANITATION COMPACT. W70-03415	05G
LEVEE AND DRAINAGE DISTRICTS. W70-03416	06A
APPEALS IN DRAINAGE AND LEVEE DISTRICT PROCEEDINGS. W70-03417	06E
WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS).	

W70-03418	06E	
ESTABLISHMENT OF DRAINAGE DISTRICTS BY MUTUAL CONSENT.	04A	TERTIARY TREATMENT ISRAEL TURNS TO SEWAGE FOR WATER. W70-03270
W70-03419		05D
TENNESSEE RIVER BASIN POLLUTION CONTROL.	05G	
W70-03420		
WATER RESOURCES.	06B	TERTIARY TREATMENT EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE, W70-03612
W70-03421		05D
TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.	06B	
W70-03422		
BOATING SAFETY ACT OF 1965.	06E	TEST PROCEDURES NONDESTRUCTIVE TESTING, W70-03356
W70-03423		07B
WATER WELLS.	04B	TEST RESULTS DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354
W70-03424		08C
OIL AND GAS.	08G	
W70-03425		
DRIPTING AND FLOATING TIMBER.	06E	TESTING DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354
W70-03426		08G
TELEGRAPH AND TELEPHONES.	06E	JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY, W70-03555
W70-03427		08B
LEVEES.	04A	TESTING EQUIPMENT NONDESTRUCTIVE TESTING, W70-03356
W70-03581		07B
DRAINAGE AND LEVEE DISTRICTS.	04A	
W70-03582		
ESTABLISHMENT OF DRAINAGE AND LEVEE DISTRICTS.	04A	TEXAS RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459
W70-03583		02F
WATERS, DRAINS AND LEVEES (DRAINAGE DISTRICTS).	04A	OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY, TEXAS, W70-03460
W70-03584		02F
DRAINAGE SUBDISTRICTS.	04A	BASE-FLOW STUDIES OF LEON AND LAMPIAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968, W70-03466
W70-03585		02E
PUBLIC UTILITIES AND CARRIERS.	06E	HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, EBRAZOS RIVER BASIN, TEXAS, 1955-64, W70-03467
W70-03586		02E
WATER AND WATERWORKS COMPANIES.	06E	
W70-03587		
BRIDGE COMPANIES (CONSTRUCTION OF BRIDGES AND INTERFERENCE WITH NAVIGATION).	04A	TERMAL POLLUTION SOME WATER QUALITY ASPECTS OF THE UPPER ROCANKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE, W70-03244
W70-03588		05C
GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION).	06E	HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540
W70-03590		05B
HEALTH AND SAFETY (MALARIA).	06E	EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF- PURIFICATION OF WATERS, W70-03547
W70-03591		05C
PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES).	04A	
W70-03592		
CRIMINAL OFFENSES ARSON AND FRAUD.	06E	TERMAL POWER PLANT WATER SUPPLY TO TERMAL POWER PLANTS, W70-03548
W70-03593		03E
WATERS AND WATERCOURSES CRIMINAL OFFENSES.	06E	
W70-03594		
CRIMINAL OFFENSES NUISANCES.	06E	TERMAL RESISTANCE AN EFFECT OF WATER HARDNESS IN THE TERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDNERII RICHARDSON, W70-03554
W70-03595		05C
WATERS AND WATERCOURSES CRIMINAL OFFENSES.	06E	
W70-03596		
W70-03597	06E	TERMAL STRATIFICATION HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAPY RESERVOIR (1958-1960), W70-03541
		02B
W70-03598	06E	HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551
LAND FOR INSTITUTIONAL WATER OR SEWAGE SYSTEM.	06E	05A
W70-03599		
CONCURRENT JURISDICTION OF THE MISSISSIPPI RIVER.	06E	TERMAL WATER ALGAI GROWTH AND PRIMARY PRODUCTIVITY IN A TERMAL STREAM, W70-03309
W70-03600		05C
JURISDICTION OVER BOUNDARY WATERS.	06E	
W70-03601		
SUPERVISION OF LOCAL IMPROVEMENTS.	06E	TERMOBIOLOGY ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A TERMAL STREAM, W70-03309
W70-03602		05C
TENNESSEE RIVER		
TENNESSEE RIVER BASIN POLLUTION CONTROL.	05G	TIDES TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DADE COUNTY, FLORIDA, W70-03268
W70-03420		02L
TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.	06B	
W70-03422		
W70-03598	06E	TILE DRAINS TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA, W70-03357
		04A
TENNESSEE RIVER BASIN		
TENNESSEE RIVER BASIN POLLUTION CONTROL.	05G	TILE FIELDS HEALTH WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTANBURG COUNTY, AIKEN COUNTY). W70-03632
W70-03420		05F
TERRAIN ANALYSIS		
RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES,	02E	TIME SERIES ANALYSIS COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY, W70-03256
W70-03487		07C
TIMSAN		
SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN).		

W70-03523	05C	W70-03369	08C
TISSUE EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C	TURBULENCE ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY, W70-03259	02L
TISSUE CHANGES TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION, W70-03326	05C	TURBULENT FLOW ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS, W70-03545	08E
TOILETS HEALTH WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY). W70-03632	05F	HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551	05A
TOLL BRIDGES HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS). W70-03642	06E	TURKEY SUBAERIAL CEMENTATION AND SUBSEQUENT DOLONITIZATION OF LACUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ("SALT LAKE"), TURKEY, W70-03446	02J
TOLLS BRIDGE COMPANIES. W70-03409	06E	UNDERGROUND CORROSION POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND, W70-03365	08G
TORREY CANYON THE EFFECTS OF OIL-SPILL REMOVERS ("DETERGENTS") ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513	05C	UNDERGROUND EXPLOSIONS NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362	08H
TOWNSHIP DITCHES WATER SUPPLY--SANITATION--DITCHES. W70-03404	04A	VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D
TRANSMISSION TELEGRAPH AND TELEPHONES. W70-03427	06E	MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS, W70-03375	08H
TRANSPORTATION LANDING AND LOADING FACILITIES. W70-03414	06E	UNDERSTORY PLANTS ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
TRAPPING FISH TRAPS LICENSING AND REGULATION. W70-03638	06E	UNITED STATES GRACI V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR NEGLIGENCE IN CONSTRUCTION OF NAVIGATION AID PROJECT). W70-03444	04A
TREATMENT FACILITIES PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES. W70-03345	05G	A UNITED STATES POLICY FOR THE WET FRONTIER, W70-03627	06E
AN ANSWER TO STREAM POLLUTION-STREAM POLLUTION REDUCTION PROGRAM FOR FINISHING PLANT. W70-03537	05D	UNSATURATED FLOW SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA, W70-03297	02F
TRITIUM SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII. W70-03613	02A	THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DEAINAGE, W70-03495	02G
TROPICAL RAINFALL RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS, W70-03479	02B	URANIUM RADIOISOTOPES THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CRECNEATE SEDIMENTS, W70-03468	02K
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM, W70-03480	02B	URBAN FLOOD-CONTROL RESERVOIRS WATER RESERVOIR SYSTEMS. W70-03435	04A
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA, W70-03481	02B	URBANIZATION WATER RESERVOIR SYSTEMS. W70-03435	04A
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA, W70-03482	02B	URINALS HEALTH WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY). W70-03632	05F
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. TRENDS IN THE RAINFALL, W70-03485	02B	URINE THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-03524	05C
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA. W70-03486	02B	URINE EXCRETION RATES THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-03524	05C
TSUNAMIS CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS, W70-03476	02L	USSR THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN). W70-03474	07A
TUNNEL LININGS PRESTRESSING OF THE LINING OF A HYDROTECHNIC TUNNEL IN A WATERTIGHT ROCK MASS BY GROUTING, W70-03367	08E	UTAH GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966, W70-03279	02H
TURBIDITY A NEW RECORDING TURBIDITY METER FOR RIVERS. W70-03277	07B	RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH, W70-03454	02F
NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN, W70-03463	02L	UTILITIES MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE EAST, W70-03376	08C
TURBINE PARTS EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT,		VELOCITY DISTRIBUTION MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	08B
28		VENEZUELA RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA,	

W70-03484	02B	DEFENSE).	06B
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL, W70-03485	02B	CONSERVANCY DISTRICTS (WATERCOURSES, WATER RIGHTS AND USES, AND CONSTRUCTION AND MAINTENANCE OF RECREATIONAL FACILITIES)-	04A
VERTEBRAE EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRAE AND FIN RAYS IN YOUNG CHINOOK SALMON, W70-03557	05C	W70-03393 W70-03395	04A
VESSELS CRIMINAL OFFENSES ARSON AND FRAUD. W70-03593	06E	WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS). W70-03401	04A
VIBILITY REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) PRED SURLETHAL CONCENTRATIONS OF DDT, W70-03515	05C	CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS). W70-03406	04A
VIBRATIONS VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D	WATER RESOURCES. W70-03421	06B
VIRGINIA SOME WATER QUALITY ASPECTS OF THE UPPER ROANCKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE, W70-03244	05C	GREAT LAKES BASIN COMPACT. W70-03577	06B
VOLCANOES TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J	SOIL AND WATER CONSERVATION COMMISSION. W70-03578	06B
VOLUME EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESmus CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D	WATER COOLING USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-03549	05B
VORTICES ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY, W70-03259	02L	WATER COSTS REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER, W70-03453	03A
WASTE ASSIMILATIVE CAPACITY THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY, W70-03550	05C	WATER DEVELOPMENT INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES. W70-03348	06B
WASTE DISPOSAL ESTABLISHMENT OF TOWN SANITARY DISTRICTS. W70-03344	05E	WATER DEVELOPMENT AUTHORITY WATER DEVELOPMENT AUTHORITY. W70-03575	06B
WATERCRAFT NAVIGATION. W70-03408	06E	WATER DISTRICTS LEVEE DISTRICTS. W70-03302	04A
DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4, W70-03442	05E	OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION). W70-03564	04A
WASTE TREATMENT CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT, W70-03433	05D	WATER IMPROVEMENTS CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS). W70-03406	04A
WASTE WATER TREATMENT A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES, W70-03346	05D	WATER INTAKES MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	06B
WASTES EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESmus CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D	WATER LEVEL FLUCTUATIONS MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS, W70-03375	08H
WATER ANALYSIS NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351	05A	WATER LEVELS ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, W70-03443	02F
WATER AND SEDIMENT A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	WATER LEVELS HYDRAULIC CONTROLS OF WATER LEVEL, W70-03373	08C
WATER CHEMISTRY NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION, W70-03265	05A	WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, W70-03443	02F
POISONING THE WELLS. W70-03276	05B	RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459	02F
GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966, W70-03279	02B	WATER LOSS ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION, W70-03449	02D
STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS, W70-03447	02J	WATER MANAGEMENT (APPLIED) THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO, W70-03246	04A
WATER CONSERVATION LAND AND WATER CONSERVATION FUND ACT. W70-03390	06B	DRAINAGE. W70-03347	04A
LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR). W70-03391	06B	WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS). W70-03397	03D
LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE). W70-03392	06B	WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS). W70-03401	04A
LAND AND WATER CONSERVATION ACT (DEPARTMENTS OF COMMERCE AND		SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-03496	02A
		APPOINTMENT, POWERS, AND DUTIES OF DRAINAGE BOARD. W70-03618	04A
		WATER MEASUREMENT THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN). W70-03474	07A
		WATER POLICY THE ORGANIZATION, PURPOSES, AND POWERS OF A SANITARY DISTRICT.	

SUBJECT INDEX

WAT-WAT		
W70-03399	05G	(DUTCH), W70-03269
DUTIES OF SANITARY DISTRICTS REGARDING POLLUTION, WATER SUPPLY, MOSQUITO CONTROL, AND INVESTIGATIONS OF RAINFALL AND STREAMFLOW. W70-03400	05G	05B
LFGAL VIEWPOINT (WATER STANDARDS), W70-03561	05G	HYDROGEN SULFIDE ODOR THRESHOLD, W70-03275
WATER POLLUTION LAKE MICHIGAN BEACH SURVEY 1968. W70-03339	05C	05A
CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION. W70-03364	05G	LAKE MICHIGAN BEACH SURVEY 1968. W70-03339
POWERS OF THE WATER POLLUTION CONTROL BOARD. W70-03398	05G	05C
TENNESSEE RIVER BASIN POLLUTION CONTROL. W70-03420	05G	A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES, W70-03346
THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN, W70-03504	05B	05D
WATERS AND WATERCOURSES CRIMINAL OFFENSES. W70-03594	06Z	ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428
CRIMINAL OFFENSES NUISANCES. W70-03595	06E	A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437
HEALTH WATER, SEWAGE, GARBAGE. W70-03629	05F	RESEARCH ON TASTES AND ODORS, W70-03440
HEALTH WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE). W70-03630	05F	OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKLEFORD COUNTY, TEXAS, W70-03460
CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION). W70-03644	05G	02F
WATER POLLUTION CONTROL REPORT OF COMMITTEE ON POLLUTION. W70-03378	05G	CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473
LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS). W70-03394	06B	07C
POWERS OF THE WATER POLLUTION CONTROL BOARD. W70-03398	05G	USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03488
CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT. W70-03433	05D	05B
USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03488	05B	LEGAL VIEWPOINT (WATER STANDARDS), W70-03561
WATER DEVELOPMENT AUTHORITY. W70-03575	06B	05G
WATER POLLUTION EFFECTS THE EFFECTS OF OIL-SPILL REMOVERS ('DETERGENTS') ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY. W70-03513	05C	WATER QUALITY CONTROL WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269
WATER POLLUTION SOURCES OFFSITE RADICALOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968. W70-03452	05A	05B
A NEW POLLUTION PROBLEM, W70-03456	05B	LAND AND WATER CONSERVATION FUND ACT. W70-03390
WATER POLLUTION TREATMENT CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION). W70-03644	05G	06B
WATER POLLUTION WATER AND WATERWORKS COMPANIES. W70-03587	06E	AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, W70-03619
WATER PRESSURE DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES. W70-03247	06D	05G
WATER PRICING PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL. W70-03439	05G	WATER QUALITY STANDARDS LEGAL VIEWPOINT (WATER STANDARDS), W70-03561
WATER QUALITY STUDIES RELATING TO WATER MINERALIZATION AND HEALTH, W70-03252	05C	05G
A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA. W70-03260	05C	WATER RATES PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL. W70-03439
QUALITY OF SURFACE WATERS OF SOUTH CAROLINA A SUMMARY OF DATA, 1945-1968, W70-03266	05B	05G
WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER		PAYMENTS TO STATE FOR WATERS DIVERTED. W70-03517
		06D
		WATER RESOURCES THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245
		06B
		HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO. W70-03254
		02F
		HYDROGEOLOGY OF A VOLCANIC ISLAND CHE JU DO, KOREA, W70-03258
		02F
		GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA, W70-03267
		04B
		MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278
		02E
		GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA, W70-03306
		02F
		WATER RESOURCES. W70-03421
		06B
		RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH, W70-03454
		02F
		OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKLEFORD COUNTY, TEXAS, W70-03460
		02F
		GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL MINNESOTA, W70-03477
		02F
		WATER RESOURCES BIBLIOGRAPHY THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245
		06B
		WATER RESOURCES DEVELOPMENT THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO, W70-03246
		04A
		INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES. W70-03348
		06B
		LAND AND WATER CONSERVATION FUND ACT.

SUBJECT INDEX

WAT-WEA

W70-03390	06B	CONFIGURATION, MISSISSIPPI RIVER AT RED RIVER LANDING, LOUISIANA, W70-03552	05C
LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR).	06B	AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDNERII RICHARDSON, W70-03554	05C
LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE).	06B	TEMPERATURES SELECTED BY TILAPIA MOSSANICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT, W70-03556	05C
LAND AND WATER CONSERVATION ACT (DEPARTMENTS OF COMMERCE AND DEFENSE).	06B	WATER TREATMENT DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4, W70-03442	05E
LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS).	06B	WATER USE COST COST HANDBOOK FOR INDUSTRIAL WATER USES, W70-03432	06C
WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS).	04A	WATER UTILIZATION DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARVING WATER PRESSURES, W70-03247	06D
WATERS, WATERWAYS, DRAINS AND LEVEES (WATERCOURSES).	04A	CONSERVANCY DISTRICTS (WATERCOURSES, WATER RIGHTS AND USES, AND CONSTRUCTION AND MAINTENANCE OF RECREATIONAL FACILITIES).	04A
WATER RESOURCES.	06B	THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C
W70-03421	06B	WATER UTILIZATION COST COST HANDBOOK FOR INDUSTRIAL WATER USES, W70-03432	06C
WATER AND MAN A WORLD VIEW,	06G	WATER WELLS WATER WELLS.	04B
W70-03450	06G	WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, W70-03443	02F
ARROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING,	06G	WATER WORKS ESTABLISHMENT OF TOWN SANITARY DISTRICTS.	05E
W70-03465	06G	WATERS AND WATERCOURSES CRIMINAL OFFENSES.	06E
STATE WATER POLICY COMMISSION - POWERS AND DUTIES.	04A	HEALTH WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE).	05F
W70-03499	04A	WATERCOURSES (LEGAL) CONTROL AND IMPROVEMENT OF NATURAL WATERCOURSES.	04A
W70-03514	04A	SUPERVISION OF LOCAL IMPROVEMENTS.	06E
WATER DEVELOPMENT AUTHORITY.	06B	WATERSHED PLANNING SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,	02A
W70-03575	06B	WATERSHEDS (BASINS) HEALTH WATER, SEWAGE, GARBAGE (PRIVIES, SEWAGE SYSTEMS, SEPTIC TANKS).	05F
GREAT LAKES BASIN COMPACT.	06B	WAVES (WATER) INTERNAL STRUCTURE OF WAVE-FORMED RIFLE MARKS IN THE NEARSHORE ZONE.	02L
W70-03577	06B	WEATHER PATTERNS RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS.	02B
SOIL AND WATER CONSERVATION COMMISSION.	06B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM,	02B
W70-03578	06B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA,	02B
WATER REUSE INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y.,	04B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA,	02B
W70-03249	04B	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS,	02B
OPPORTUNITIES FOR WATER SALVAGE,	05D	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA,	02B
W70-03251	05D	RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL,	02B
ISRAEL TURNS TO SEWAGE FOR WATER.	05D		
W70-03270	05D		
WATER RIGHTS LAND FOR INSTITUTIONAL WATER OR SEWAGE SYSTEM.	06E		
W70-03599	06E		
WATER SOURCES HEALTH WATER, SEWAGE, GARBAGE (PRIVIES, SEWAGE SYSTEMS, SEPTIC TANKS).	05F		
W70-03631	05F		
WATER STORAGE THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION,	02A		
W70-03292	02A		
WATER-SUPPLY MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT,	02E		
W70-03278	02E		
COUNTY WATER SUPPLY SYSTEMS.	04A		
W70-03396	04A		
WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS).	03D		
W70-03397	03D		
THE ORGANIZATION, PURPOSES, AND POWERS OF A SANITARY DISTRICT.	05G		
W70-03399	05G		
DUTIES OF SANITARY DISTRICTS REGARDING POLLUTION, WATER SUPPLY, MOSQUITO CONTROL, AND INVESTIGATIONS OF RAINFALL AND STREAMFLOW.	05G		
W70-03400	05G		
DIVISION OF WATER DEVELOPMENT.	03B		
W70-03491	03B		
STATE WATER POLICY COMMISSION - POWERS AND DUTIES.	04A		
W70-03514	04A		
HEALTH WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE).	05F		
W70-03630	05F		
WATER TEMPERATURE SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,	05C		
W70-03244	05C		
EFFECT OF WATER TEMPERATURE ON DISCHARGE AND BED			

SUBJECT INDEX

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MFSOSCALE SYSTEMS PART II. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA. W70-03486	02B	WATERWORKS AND SEWERAGE. W70-03535	05G
WEISS RESERVOIR THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY, W70-03550	05C	OBSTRUCTIONS IN NON-NAVIGABLE WATERS. W70-03536	04A
WELL CASINGS CTL AND GAS. W70-03425	08G	HIGHWAY TO ISLANDS IN MISSISSIPPI RIVER. W70-03538	04A
WELL REGULATIONS WATER WELLS. W70-03424	04E	APPOINTMENT, POWERS, AND DUTIES OF DRAINAGE BOARD. W70-03618	04A
WELLS OIL AND GAS. W70-03425	08G	ORGANIZATION OF DRAINAGE DISTRICTS. W70-03628	04A
WETTING AGENTS SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C	DAMS AND BRIDGES (PROCEDURES REGARDING WATER POWER PERMITS). W70-03640	06E
WHITECAPS (WATER WAVES) LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS, W70-03451	01B	PUBLIC DOMAIN AND TRUST FUNDS (DAMS AND BRIDGES). W70-03641	06E
WILDLIFE CONSERVATION DIVISION OF WILDLIFE. W70-03588	06E	HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS). W70-03642	06E
WILDLIFE MANAGEMENT DIVISION OF WILDLIFE. W70-C3588	06E	WOOL AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY. W70-03531	05D
WISCONSIN ECOLOGY OF CHIRONOMIDAE, CHAOBRIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES. W70-03333	02R	WROUGHT IRON OIL AND GAS. W70-03425	08G
ESTABLISHMENT OF TOWN SANITARY DISTRICTS. W70-03344	05E	WYOMING SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA. W70-03457	02J
PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES. W70-03345	05G	X-RAY ANALYSIS X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS. W70-03286	02J
PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS, W70-03380	06E	A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS. W70-03470	07B
AUTHORITY OF CITIES TO DEVELOP SEWAGE SYSTEMS, AND TO IMPROVE LAKES AND WATERCOURSES. W70-03534	05G	ZOOPLANKTON A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR. W70-03311	02H
		PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H
		2-4-D AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C

AUTHOR INDEX

ABRAHAM, G.		BARGUR, JONA	
ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS, W70-03545	08B	ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G
ABREFSKAYA, S. I.		BARKER, G. R.	
COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (IN RUSSIAN), W70-03539	05C	ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND FUTURE DEVELOPMENT OF GRAND COULEE DAM, W70-03358	08C
ADAMS, DONALD D.		BARNES, ALBERT H.	
DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS, W70-03503	05B	COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION, W70-C3295	02E
AHLGREN, INGEMAR		BECKER, ALFRED	
Limnological STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET, W70-03322	02H	THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION, W70-03292	02A
ALABASTER, J. S.		BELL, F. C.	
SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C	AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION, W70-03291	02A
ALLEN, W. H., JR.		BENDER, MICHAEL	
HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING, W70-03493	02G	THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS), W70-03518	05C
AMBERG, H. B.		BENDER, MICHAEL E.	
AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN, W70-03625	05G	UPTAKE AND RETENTION OF MALATHION BY THE CARP, W70-03516	05C
AMEND, DONALD F.		BERG, W. A.	
SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN), W70-03523	05C	DETERMINING PH OF STRIP-MINE SPOILS, W70-03281	05A
AMES, L. L.		BERNADELLI, P.	
EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE, W70-03612	05D	ASSESSING OUTDOOR INSULATION, W70-03368	08C
ANDERSON, J. B.		BIRKNER, FRANCIS B.	
Thermal-Hydraulic Study - ARKANSAS COOLING RESERVOIR, W70-03542	05D	NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION, W70-03265	05A
ANDREWS, C. W.		BLACK, T. A.	
EFFECT OF HEAT ON THE LIGHT BEHAVIOR OF FISH, W70-03558	05C	ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION, W70-03449	02D
ANGINO, ERNEST E.		BOCKER, T.	
IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO, W70-03471	02J	KARSTIC WATER RESEARCH IN HUNGARY, W70-03264	02F
ARAL, MUSTAFA M.		BOEHNKE, B.	
THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J	EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS, W70-03547	05C
ARMSTRONG, RICHARD		BOERSMA, J. R.	
I. PRODUCTIVITY PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA, W70-03508	05C	INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER- POINTBAR DEPOSITS, LOWER RHINE), W70-03289	02J
ARTHUR, JAMES		BOHANNON, JAMES E., JR.	
EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D	NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351	05A
ASPIRARTE, T. B.		BOHAN, JOSEPH R.	
AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN, W70-03625	05G	MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	08B
ATTIWELL, P. B.		BOWLES, DUAIN	
DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES, W70-03285	02J	THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM, W70-03615	07A
BAARS, J. K.		BOYCE, CARL J.	
Possibilities for MINERALIZATION OF PESTICIDES (DUTCH), W70-03271	05G	THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN, W70-03504	05B
BACHMAN, ROGER W.		BOYCE, EARNEST	
HYPOMILLIMETRIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551	05A	INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES, W70-03348	06B
BADENHUIZEN, T. R.		BRAMER, HENRY C.	
TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT, W70-03556	05C	THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C
BAPPA, JOHN J.		COST HANDBOOK FOR INDUSTRIAL WATER USES, W70-03432	06C
INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y., W70-03249	04B	BRICE, ROBERT M.	
BAGGE, CARL E.		THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT, W70-03512	05C
MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE PAST, W70-03376	08C	BRIGGS, P. C.	
BAKER, SEYMOUR R.		GROUNDWATER CONDITIONS IN THE RANEGAS PLAIN, YUMA COUNTY, ARIZONA, W70-03267	04B
A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS, W70-03470	07B		

AUTHOR INDEX

BRI-DMI	
BRINKHURST, R. O.	
COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES, W70-03315	02B
BRÖCKSEN, ROBERT W.	
ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS, W70-03525	05C
BROGAN, T. R.	
MHD POWER GENERATION CURRENT STATUS, W70-03374	08C
BROOKS, NORMAN B.	
DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING, W70-03553	08B
DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY' BY G. ABRAHAM, W70-03560	08B
BROUWER, W. A. B.	
WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH), W70-03269	05B
BROWN, RANDALL	
EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D
BROWN, R. F.	
THE EFFECT OF SOME MYCOTOXINS ON THE BEINE SHRIMP, ATEMIA SALINA, W70-03528	05C
BROWN, W.	
POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS, W70-03438	05G
BRUTSAERT, WILFRID	
THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE, W70-03495	02G
BRYAN, G. H.	
THE EFFECTS OF OIL-SPILL REMOVERS ('DETERGENTS') ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513	05C
BURRY, RAYMOND J., III.	
THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B
BURKE, P. P.	
EFFECT OF WATER TEMPERATURE ON DISCHARGE AND BED CONFIGURATION, MISSISSIPPI RIVER AT RED RIVER LANDING, LOUISIANA, W70-03552	05C
BURRIS, ROBERT H.	
BIOLOGICAL N2 FIXATION IN LAKES, W70-03429	05C
BUSCEMI, PHILIP A.	
CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE, W70-03501	05B
BUSCH, WILLIAM F.	
EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIONEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA), W70-03458	02E
BUTLER, PHILIP A.	
INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621	05C
Buzzell, JAMES C., JR.	
MEASUREMENT OF PHOSPHORUS IN WASTEWATER, W70-03331	05A
CARLSON, DALE A.	
CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT, W70-03433	05D
CARLSTON, CHARLES W.	
LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES, W70-03255	02E
CAWLEY, WILLIAM A.	
THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY, W70-03550	05C
CEDERWALL, KLAS	
JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY, W70-03555	08B
CHADWICK, GEORGE G.	
ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS, W70-03525	05C
CHASE, E. B.	
CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473	07C
CIRCEI, L. J., JR.	
NUCLEAR EXCAVATION REVIEW AND ANALYSIS, W70-03362	08B
COBB, L. GLEN	
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS, W70-03479	02B
COOK, S. F., JR.	
THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C
COOPAGE, DAVID L.	
INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621	05C
COPE, OLIVER B.	
THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES, W70-03526	05C
CORDERO, ISIDORO A.	
THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO, W70-03246	04A
COREY, A. T.	
SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA, W70-03297	02F
COWLISHAW, WAYNE	
A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES, W70-03346	05D
CRAIGIE, DAVID E.	
AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDRIVERII RICHARDSON, W70-03554	05C
CROOK, KEITH A. W.	
WEATHERING AND ROUNDNESS OF QUARTZ SAND GRAINS, W70-03283	02J
CRUSE, HENRY	
HYDROGEN SULFIDE ODOR THRESHOLD, W70-03275	05A
CUMMINGS, T. RAY	
QUALITY OF SURFACE WATERS OF SOUTH CAROLINA A SUMMARY OF DATA, 1945-1968, W70-03266	05B
CUMMING, KENNETH B.	
SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE, W70-03244	05C
DANIELS, LEWIS A.	
ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
DAVIS, H. C.	
ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G
DAVIS, STANLEY N.	
MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, W70-03455	02G
DAVIDOV, S. S.	
CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS, W70-03372	08P
DAY, RICHARD L.	
A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEANWATER MOUNTAINS, IDAHO, W70-03645	02B
DENDY, JACK S.	
WATER TEMPERATURE AND SPRING FISHING, MORRIS RESERVOIR, TENNESSEE, W70-03559	05C
DICKMAN, MIKE	
SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02H
DICKS, J. B.	
MHD POWER GENERATION CURRENT STATUS, W70-03370	08C
DING, J. Y.	
FLOW ROUTING BY DIRECT INTEGRATION METHOD, W70-03294	02E
DION, H. P.	
HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO, W70-03254	02F
DMITRIEVA, E. G.	

RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT, W70-03371	08F	W70-03553	08B
DOYLE, ROGER H. OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA, W70-03386	06E	DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY' BY G. ABRAHAM, W70-03560	08B
CWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY I), W70-03387	06E	FAN, L. T. OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS, W70-03614	05D
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY II), W70-03388	06E	FELL, LLOYD C. MARITIME CONTIGUOUS ZONES, W70-03381	06E
OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES), W70-03389	06E	FISH, FREDERIC F. THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER, W70-03546	05C
DRUMMOND, WAYMON BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C	FITZGERALD, GEORGE P. CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE, W70-03310	05G
DUCAB, G. J. MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS, W70-03610	05G	THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA, W70-03507	05C
DUCE, ROBERT A. SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII, W70-03613	02A	FOSTER, THEODORE D. EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER, W70-03464	02C
DUGAN, PATRICK R. PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505	05B	FREIA, JAMES I. PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505	05B
DUGDALE, RICHARD C. NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA, W70-03511	05C	FRIEDMAN, GERALD M. THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS, W70-03468	02K
DUGDALE, VERA A. NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA, W70-03511	05C	A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS, W70-03470	07B
DYSART, BENJAMIN C., III. AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT, W70-03619	05G	FROMM, PAUL O. RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIERNERI) TO STRESS, W70-03527	05C
ECKSTETIN, YORAM HYDROGEOLGY OF A VOLCANIC ISLAND CHE JU DO, KOREA, W70-03258	02F	GABRYSCH, B. K. RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459	02F
EDDY, F. B. SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIERNERI RICHARDSON, W70-03522	05C	GARBER, M. S. MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SUBCOUNING AQUIFERS, W70-03375	08H
EDMONDS, PHILIP H. EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C	GARDNER, DONALD K. THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT, W70-03342	06F
EDZWALD, J. K. NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION, W70-03265	05A	GARDNER, W. R. ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION, W70-03449	02D
EIJPEL, R. AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J	GERLOFF, GERALD C. THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA, W70-03507	05C
EISLER, RONALD EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C	GOLDMAN, CHARLES R. I. PRODUCTIVITY PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA, W70-03508	05C
TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXICHLOR AND METHYL PARATHION, W70-03326	05C	HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551	05A
ELWIN, E. HARVEY STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543	08B	GOODE, HARRY D. RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH, W70-03454	02F
ENGLAND, C. B. HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING, W70-03493	02G	GOODMAN, ALVIN S. USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03488	05B
ERICKSON, L. E. OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS, W70-03614	05D	GRACE, JOHN L. MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	08B
ESTES, R. DON SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE, W70-03244	05C	GRASS, LUTHER B. TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA, W70-03357	04A
FABER, HARRY A. DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4, W70-03442	05E	GRIFFITHS, JOHN F. RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS, W70-03479	02B
PAN, LOH-NIEN DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING,		RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL DISTRIBUTIONS, W70-03483	02B
		RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN VENEZUELA,	

W70-03484	02B	HILMY, E.	GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R.,
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL, W70-03485	02B	W70-03469	02L
GUTTORMSEN, KRISTIAN CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT, W70-03433	05D	HILSENHOFF, WILLIAM L.	ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES,
HAGEMANN, R. VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA, W70-03461	02C	W70-03333	02B
HAGLUND, DAVID S. THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS, W70-03468	02K	HIRST, D. M.	DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES,
HAHL, D. C. GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966, W70-03279	02R	W70-03285	02J
HALDERMAN, ALLAN D. MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, W70-03455	02G	HOLLAND, R. T.	INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS,
HAMILTON, A. L. COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES, W70-03315	02R	W70-03621	05C
HANDY, A. H. GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966, W70-03279	02R	HOLMES, R. T.	THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR,
HANSEN, DAVID J. AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C	W70-03542	05D
HARTS, K. F. CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473	07C	HOLM-HANSEN, OSMUND ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE,	W70-03335
HAWKINS, LARRY K. VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE BLAKE PLATEAU, W70-03462	02J	HOLTAN, H. N.	HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING,
HEALY, HENRY G. WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, W70-03443	02F	W70-03493	02G
HENDERSON, PATRICIA L. PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING, W70-03287	02J	HOOPER, LESLIE USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,	W70-03549
HENRY, WALTER K. RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS, W70-03479	02B	HORIE, SHOJI STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM,	W70-03319
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM, W70-03480	02B	HOWARD, JAMES D.	X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS,
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA, W70-03481	02B	W70-03266	02J
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR COLOMBIA, W70-03482	02B	HRBACEK, J.	HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAVY RESERVOIR (1958-1960).
HERRINGTON, H. B. COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES, W70-03315	02H	W70-03541	02H
HERSHFIELD, DAVID M. GENERALIZING DRY-DAY FREQUENCY DATA, W70-03441	02B	HUFFEN, THEODORE H.	SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII,
HIGGINS, DONALD H. EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL, W70-03436	02A	W70-03613	02A
HILL, CLIFF W. RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GARDNERI) TO STRESS, W70-03527	05C	HUNKINS, KENNETH NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN,	W70-03463
HILL, DIXON OFFSITE RADONLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968, W70-03452	05A	HUTCHINSON, CURT THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES,	W70-03526
HILL, H. B. VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS, W70-03303	07C	IBRAHIM, HASSAN A.	THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,
JACKSON, M. D. A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	W70-03495	02G
JAMES, W.	A NEW RECORDING TURBIDITY METER FOR RIVERS,	W70-03277	07B
JANKOVIC, STEVAN G.	MEASUREMENT OF PHOSPHORUS IN WASTEWATER,	W70-03331	05A
JANNASCH, HOLGER W.	EDGARDO BALDI MEMORIAL LECTURE CURRENT CONCEPTS IN EQUATIC MICROBIOLOGY,	W70-03510	05C
JENKINS, ROBERT H.	THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN US RESERVOIRS,		

AUTHOR INDEX

JEN-MCG

- W70-03324 02H
 JENSEN, ALBERT C.
 FISH AND POWER PLANTS,
 W70-03250 05C
- JOBLING, G. A.
 THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW,
 W70-03492 02A
- JONES, D. A.
 POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS
 BURIED UNDERGROUND,
 W70-03365 08G
- KADOYA, MUTSUMI
 A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC
 QUANTITIES,
 W70-03305 02A
- ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS,
 W70-03489 02A
- KHOLTEF, M. M.
 GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS
 IN THE NILE DELTA, U.A.R.,
 W70-03469 02L
- KISTER, L. R.
 MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER
 RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT,
 W70-03278 02E
- KLEMPS, VIT
 RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL
 INPUT,
 W70-03498 04A
- KLOMPE, KITTY C.
 DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4,
 W70-03422 05E
- KNOCHENMUS, DARWIN
 A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND
 WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,
 W70-03260 05C
- KOBAYASHI, R. J.
 POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION
 GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS,
 W70-03438 05G
- KOS, DENNIS
 SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES,
 W70-03646 03A
- KOS, ZDENEK
 SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
 W70-03496 02A
- KRENKEL, PETER A.
 THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE
 ASSIMILATIVE CAPACITY,
 W70-03550 05C
- KRSMANOVIC, D.
 PRESTRESSING OF THE LINING OF A HYDROTECHNIC TUNNEL IN A
 WATERTIGHT ROCK MASS BY GROUTING,
 W70-03367 08E
- KRUGER, PAUL
 THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC
 TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,
 W70-03296 02A
- KULANDAISWAMY, V. C.
 A NONLINEAR APPROACH TO RUNOFF STUDIES,
 W70-03290 02A
- LANGFORD, R. R.
 FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO,
 W70-03323 02H
- LANGOF, Z.
 PRESTRESSING OF THE LINING OF A HYDROTECHNIC TUNNEL IN A
 WATERTIGHT ROCK MASS BY GROUTING,
 W70-03367 08E
- LAU, I. STEPHEN
 SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL
 WATER OF SOUTHERN OAHU, HAWAII,
 W70-03613 02A
- LAVOIE, FRANCIS J.
 NONDESTRUCTIVE TESTING,
 W70-03356 07B
- LAW, ALBERT G.
 EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION
 MODEL,
 W70-03486 02A
- LENZ, FRANZ
 CHIRONOMIDA AND THE STUDY OF LAKE TYPES,
 W70-03332 02H
- LEVIN, P.
 MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED
 INCINERATOR CAPACITIES AND COSTS,
 W70-03610 05G
- LIAO, K. H.
 BRANCHING-TYPE MODELS OF FLOW THROUGH POROUS MEDIA,
 W70-03262 02F
- LIGNER, J. J.
 MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER
 RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT,
 W70-03278 02E
- LIGON, JAMES T.
 EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION
 MODEL,
 W70-03436 02A
- LISITSYN, A. P.
 RECENT SEDIMENTATION IN THE BERING SEA,
 W70-03350 02L
- LITTLE, I. P.
 DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED
 SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,
 W70-03502 05A
- LLOYD, R.
 THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL
 CONCENTRATIONS OF AMMONIA,
 W70-03524 05C
- LOFTING, E. M.
 ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,
 W70-03428 05G
- LORING, D. H.
 OCCURRENCE AND SIGNIFICANCE OF IRON, MANGANESE, AND TITANIUM
 IN GLACIAL MARINE SEDIMENTS FROM THE ESTUARY OF THE ST
 LAWRENCE RIVER,
 W70-03320 02K
- LORIUS, C.
 VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN
 ANTARCTICA,
 W70-03461 02C
- LOWE, T. A.
 POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS
 BURIED UNDERGROUND,
 W70-03365 08G
- LOWHAM, HUGH W.
 SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND
 MONTANA,
 W70-03457 02J
- LUDWICK, JOHN C.
 PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING,
 W70-03287 02J
- LULHAM, ANN
 DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED
 SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,
 W70-03502 05A
- MACAVOY, P. W.
 REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER,
 W70-03453 03A
- MACEK, KENNETH J.
 REPRODUCTION IN BROOK TROUT (*SALVELINUS FONTINALIS*) FED
 SUBLETHAL CONCENTRATIONS OF EDT,
 W70-03515 05C
- THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF
 BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES,
 W70-03526 05C
- MAKOVSKII, E. E.
 HYDRAULIC CONTROLS OF WATER LEVEL,
 W70-03373 08C
- MALONEY, FRANK E.
 LEGAL VIEWPOINT (WATER STANDARDS),
 W70-03561 05G
- MARTIN, C. SAMUEL
 THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION,
 W70-03617 02J
- MARTZ, CLYDE O.
 THE FEDERAL VIEW OF DAMAGES AND BENEFITS,
 W70-03361 06E
- MATHIEU, GUY
 NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN,
 W70-03463 02L
- MCADOO, GENE
 RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN
 HARRIS COUNTY, TEXAS,
 W70-03459 02F
- MCBRIDE, JOHN R.
 OFFSITE RADIOLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE
 1967-JULY 1968,
 W70-03452 05A
- MCCABE, LELAND J.
 STUDIES RELATING TO WATER MINERALIZATION AND HEALTH,
 W70-03252 05C
- MCCAUGHEY, P. H.
 ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,

MCINTIRE, C. DAVID A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS, W70-03325	05G	COST HANDBOOK FOR INDUSTRIAL WATER USES, W70-03432	06C
LABORATORY STUDIES OF PERIPHYTON PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS, W70-03327	05C	MULLER, GERMAN SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ('SALT LAKE'), TURKEY, W70-03446	02J
MCKEEVEY, JAMES M. BUILDING A COMPUTER-BASED MIS, W70-03360	10	MYERS, LLOYD E. OPPORTUNITIES FOR WATER SALVAGE, W70-03251	05D
MCWHORTER, D. B. SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA, W70-03297	02F	MYERS, RICHARD SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES, W70-03646	03A
MERLIVAT, L. VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA, W70-03461	02C	NACE, RAYMOND L. WATER AND MAN A WORLD VIEW, W70-03450	06G
MILLER, DONALD G. CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448	08E	ABROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING, W70-03465	06G
MILLER, DONALD S. THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS, W70-03468	02K	NAPTEL, W. L. RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS, W70-03459	02P
MILLS, WILLARD B. HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, BRAZOS RIVER BASIN, TEXAS, 1955-64, W70-03467	02E	NARP, RICHARD P. ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, W70-03333	02R
MINCH, VIRGIL A. THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY, W70-03550	05C	NEALE, LAWRENCE USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-03549	05B
MISAKA, Y. FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D	NEWTON, ROBERT S. INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE, W70-03284	02L
MITCHELL, DEE T. MEASUREMENT OF PHOSPHORUS IN WASTEWATER, W70-03331	05A	NIMLOS, THOMAS J. ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
MONAHAN, EDWARD C. LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS, W70-03451	01B	NOTA, D. J. G. OCCURRENCE AND SIGNIFICANCE OF IRON, MANGANESE, AND TITANIUM IN GLACIAL MARINE SEDIMENTS FROM THE ESTUARY OF THE ST LAWRENCE RIVER, W70-03320	02K
MOORE, J. ROBERT RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES, W70-03478	02L	NOVICK, SHELDON A NEW POLLUTION PROBLEM, W70-03456	05B
MOORE, R. L. THE EFFECTS OF A BOTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C	NRIAGU, JEROME O. THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN, W70-03504	05B
MORGAN, BRIAN E. A RAINFALL RATE SENSOR, W70-03363	07B	NUNEZ, LUIS A. DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES, W70-03247	06D
MORGAN, REGINALD SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMS), W70-03523	05C	ODLAUG, THEOBORN O. LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR, W70-03329	02H
MORGAN, R. I. G. SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C	PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H
MORISAWA, MARIE E. RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES, W70-03487	02E	OLSON, THEODORE A. LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR, W70-03329	02H
MORRIS, DAVID RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS, W70-03479	02B	PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H
MORRIS, DAVID G. RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS PART II. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA, W70-03486	02B	OLSON, T. A. A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02R
MOSS, M. E. MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278	02E	ORR, LYDIA D. THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETAL CONCENTRATIONS OF AMMONIA, W70-03524	05C
MOTHERSILL, JOHN S. A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO, W70-03472	02H	PALMER, M. D. GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA, W70-03253	05B
MOTZ, DONALD J. THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C	PABARAS-CARAYANNIS, GEORGE CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS, W70-03476	02L
MOTZ, DONALD J. THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C	PETERSON, FRANK L. MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW, W70-03455	02G
MOTZ, DONALD J. THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES, W70-03431	06C	PETERSON, ROGER A. ARE WE LOSING OUR LAKES, W70-03382	06E

ARE WE LOSING OUR LAKES (STATE'S ACQUISITION OF TITLE UPON ADMISSION TO THE UNION), W70-03383	06E	DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS, W70-03503	05B
ARE WE LOSING OUR LAKES. (STATE'S ACQUISITION OF TITLE THROUGH CONSTRUCTION OF FEDERAL PATENTS ACCORDING TO LOCAL LAW), W70-03384	06E	RIESPOL, R. S. THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D
ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH THEORIES TO RETAIN CONTROL OF THE LAKES), W70-03385	06E	RIGGS, H. C. MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS, W70-03280	02E
PFISTER, ROBERT M. PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505	05B	RODHE, WILHELM PRESIDENT'S LECTURE LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNEFEST, W70-03509	02H
PHELPS, L. D. A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	RODRIGUEZ-ITURBE, IGNACIO COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY, W70-03256	07C
PHILLIPS, R. B. POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS, W70-03438	05G	ROEHL, LOUIS H. VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D
PHINNEY, HARRY K. LABORATORY STUDIES OF PERiphyton PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS, W70-03327	05C	ROLAND, FRED A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES, W70-03346	05D
PHIPPEN, GEORGE R. FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH, W70-03340	06E	ROPES, L. H. GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL MINNESOTA, W70-03477	02F
PLATT, TREVOR THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION, W70-03313	02K	ROSEN, A. A. RESEARCH ON TASTES AND ODORS, W70-03440	05F
POLKOWSKI, L. B. FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D	BOSEN, NORMAN C. HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN, W70-03445	02J
POMEROY, RICHARD D. HYDROGEN SULFIDE ODOR THRESHOLD, W70-03275	05A	ROUSE, GEORGE C. VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D
POTTER, PAUL EDWIN TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J	SAIJO, YATSUKA STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM, W70-03319	02H
POWERS, CHARLES F. THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT, W70-03512	05C	SANGAL, B. P. VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS, W70-03303	07C
PRESTON, RICHARD D. OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY, TEXAS, W70-03460	02F	SCHEIDEGGER, ADRIAN E. TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J
PROUD, G. H. DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS, W70-03502	05A	SCHEIDEGGER, A. E. BRANCHING-TYPE MODELS OF FLOW THROUGH POROUS MEDIA, W70-03262	02F
PYLAEV, N. I. THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION, W70-03366	08C	SCHER, STANLEY PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROTROPHY IN ALgal FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS, W70-03336	05C
QUIMPO, RAFAEL G. REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263	07C	SCHIEBE, F. R. HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540	05B
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS, W70-03497	02E	SCHNEIDER, JAMES J. TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DADE COUNTY, FLORIDA, W70-03268	02L
RAMCOLAM, R. B. THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245	06B	SCHROEDER, DOUGLAS THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY, W70-03338	06B
RAFF, J. R. CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473	07C	SCHROEDER, JAMES H. LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT, W70-03341	06F
RAWSON, JACK BASE-FLOW STUDIES OF LEON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968, W70-03466	02E	SCHULTZ, GERALD K. BASE-FLOW STUDIES OF LEON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968, W70-03466	02E
BEEVE, R. DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS, W70-03502	05A	SCHULTZ, VINCENT ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY, W70-03308	07B
RICE, CHARLES E. THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL, W70-03475	02E	SCHUMM, S. A. PALEHYDROLOGY APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST, W70-03490	02A
RICHARDS, ADRIAN F. CONSOLIDATION AND SEDIMENTATION-COMPRESION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS, W70-03448	08E	SEYMOUR, ALLYN EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRATE PIN RAYS IN YOUNG CHINOOK SALMON, W70-03557	05C
RICHARDS, FRANCIS A.		SHAHAT, A.	

GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L	TAO, LUH C. SURFACE PROPERTIES OF TEFLO FILM IN SALINE WATER PROCESSES, W70-03646	03A
SHEAFFER, JOHN E. A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES, W70-03346	05D	TAYLOR, R. K. DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES, W70-03285	02J
SHEDDAN, T. L. EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE, W70-03317	02H	TENORIO, PEDRO A. IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B
SHEPTS, T. J. A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	THORNDIKE, EDWARD M. NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN, W70-03463	02L
SHEN, HUNG TAO FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER, W70-03257	04B	TIBBITS, G. C., JR. GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA, W70-03306	02F
SIDDQUI, M. M. COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY, W70-03256	07C	TJALSKA, B. C. INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER- POINTBAR DEPOSITS, LOWER RHINE), W70-03289	02J
SINGER, PHILIP C. OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434	05B	TODOROVIC, PETAR A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY, W70-03301	02A
SKOOG, FOLKE CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3- DICHLORONAPHTHOQUINONE, W70-03310	05G	TOYODA, YOSHIMASA STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM, W70-03319	02H
THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA, W70-03507	05C	TUCKER, RICHARD J. USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03488	05B
SLOTTA, LARRY S. STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543	06B	TURNER, A. K. THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW, W70-03492	02A
SMITH, DAVID L. EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE, W70-03519	05C	UNNY, T. E. VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS, W70-03303	07C
SOTNIKOV, A. A. THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION, W70-03366	08C	VAN DE MEENE, E. A. INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER- POINTBAR DEPOSITS, LOWER RHINE), W70-03289	02J
STAMM, WERNER OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434	05B	VAN DER KNAAP, W. AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J
STANKIEWICZ, E. J. WATER SUPPLY TO THERMAL POWER PLANTS, W70-03548	03E	VAN METER, WAYNE P. ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIODIODE ABSORPTION, W70-03626	02I
STANNETT, V. T. POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS, W70-03438	05G	VANCE, B. DWAIN EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE, W70-03519	05C
STARR, CHAUNCEY SOCIAL BENEFIT VERSUS TECHNOLOGICAL RISK, W70-03377	06B	BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C
STEPAN, H. HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540	05B	VAZQUEZ, A. S. THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245	06B
STEKLOV, M. L. EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT, W70-03369	08C	VENETIS, C. A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS, W70-03274	02F
STEVENS, THEODORE P. A UNITED STATES POLICY FOR THE WET FRONTIER, W70-03627	06E	VENNES, JOHN W. MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES ON LAGOON ECOLOGY, W70-03312	05C
STOCKNER, JOHN G. ALgal GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM, W70-03309	05C	VERGHESA, KURUVILLA NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351	05A
STRASKRABA, M. HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAPY RESERVOIR (1958-1960), W70-03541	02H	VIDAL, HENRY THE PRINCIPLE OF REINFORCED EARTH, W70-03359	08D
SUBRAMANIAN, C. V. A NONLINEAR APPROACH TO RUNOFF STUDIES, W70-03290	02A	VILLANUEVA, A. R. THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245	06B
SVANIDZE, G. G. RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING, W70-03304	02A	VIVES, R. Q. THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245	06B
SWAIN, WAYLAND B. PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER, W70-03506	02H	WAGNER, GUSTAV THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (IN GERMAN), W70-03318	02H
TANNER, C. B. ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION, W70-03449	02D		

WAITE, G. GRAHAM PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS, W70-03380	06E	WISE, D. W. AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN, W70-03625	05G
WATSON, JERRY A. IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO, W70-03471	02J	WOLLITZ, L. E. MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS, W70-C3375	08H
WAY, STEWART MHD POWER GENERATION CURRENT STATUS, W70-03374	08C	WOOD, C. E. EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE, W70-03317	02H
WEAVER, JACK N. NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351	05A	WRIGHT, KENNETH R. MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL, W70-03343	04C
WEILLS, F. J. REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER, W70-03453	03A	WULFF, BARRY L. A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS, W70-03325	05C
WEND, F. H. THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D	WUNDERLICH, WALTER O. UNIVERSAL FORMULA FOR UNIFORM FLOW, W70-03248	08B
WERNIMONT, GRANT DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354	08G	YASUTAKE, WILLIAM T. SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN), W70-03523	05C
WETZEL, RONBERT G. FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES, W70-03307	02H	YEJVICH, VUJICA A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY, W70-03301	02A
WHITEHEAD, H. COLLINS IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B	YOSHIMURA, SHINKICHI CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN, W70-03316	02H
WHITE, NATALIE D. MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278	02E	YOUNG, REGINALD H. F. IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B
WILLIAMS, THEODORE T. THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM, W70-03615	07A	ZANKL, H. STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS, W70-03447	02J
WINKELMOLEN, R. H. AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J	ZHELEZNYAKOV, G. V. THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN), W70-03474	07A
WINTON, ELLIOTT F. STUDIES RELATING TO WATER MINERALIZATION AND HEALTH, W70-03252	05C	ZIETLOW, CARL R. LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS, W70-03451	01B
WISEMAN, W. J., JR. ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY, W70-03259	02L	ZUPCEVIC, H. PRESTRESSING OF THE LINING OF A HYDROTECHNIC TUNNEL IN A WATERTIGHT ROCK MASS BY GROUTING, W70-03367	08E

ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROGRAPH LAB.		FUTURE DEVELOPMENT OF GRAND COULEE DAM, W70-03358	08C
GENERALIZING DRY-DAY FREQUENCY DATA, W70-03441	02B		
HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING, W70-03493	02G	BUREAU OF RECLAMATION, DENVER, COLO. VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST, W70-03370	08D
AGRICULTURAL RESEARCH SERVICE, BRAWLEY, CALIF. TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA, W70-03357	04A	BUREAU OF SPORT FISHERIES AND WILDLIFE, COLUMBIA, MO. FISH-PESTICIDE RESEARCH LAB. THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES, W70-03526	05C
AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB. OPPORTUNITIES FOR WATER SALVAGE, W70-03251	05D	BUREAU OF SPORT FISHERIES AND WILDLIFE, FAYETTEVILLE, ARK. THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN US RESERVOIRS, W70-03324	02H
AKADEMIYA NAUK SSSR. INSTITUT OKEANOLOGII. RECENT SEDIMENTATION IN THE BERING SEA, W70-03500	02L	BUREAU OF SPORT FISHERIES AND WILDLIFE, HIGHLANDS, N.J. SANDY HOOK MARINE LAB. EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH, W70-03314	05C
AKADEMIYA NAUK URSR, KIEV. INSTYTUT HIDROBIOLOGII. COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (IN RUSSIAN), W70-03539	05C	TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION, W70-03326	05C
AMERICAN WATER WORKS ASSOCIATION, NEW YORK. DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4, W70-03424	05E	BUREAU OF WATER HYGIENE, CINCINNATI, OHIO. STUDIES RELATING TO WATER MINERALIZATION AND HEALTH, W70-03252	05C
ANTIOCH COLL., YELLOW SPRINGS, OHIO. DEPT. OF EARTH SCIENCES. RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES, W70-03487	02E	CALIFORNIA INST. OF TECH., PASADENA, CALIF. W. M. KECK LAB. OF HYDRAULICS AND WATER RESOURCES. DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING, W70-03553	08B
ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MISS. MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES, W70-03544	08B	CALIFORNIA INST. OF TECH., PASADENA. W. M. KECK LAB. OF HYDRAULICS AND WATER RESOURCES. DISCUSSION OF 'HORIZONTAL JETS IN STagnANT FLUID OF OTHER DENSITY' BY G. ABRAHAM, W70-C3560	08B
ASIAN INST. OF TECHNOLOGY, BANGKOK (THAILAND). DEPT. OF ENGINEERING. FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER, W70-03257	04B	CALIFORNIA STATE COLL., HAYWARD. DEPT. OF BIOLOGICAL AND HEALTH SCIENCES. PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROTROPHY IN ALGAL FLAGELLATES CONDITIONALLY EXPRESSED CHARACTERISTICS, W70-03336	05C
AUSTRALIAN NATIONAL UNIV., CANBERRA. DEPT. OF GEOLOGY. WEATHERING AND ROUNDNESS OF QUARTZ SAND GRAINS, W70-03283	02J	CALIFORNIA STATE DEPT. OF WATER RESOURCES, FRESNO AND FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, FRESNO, CALIF. EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-SUB-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS, W70-03334	05D
AUTONETICS DIVISION OF NORTH AMERICAN ROCKWELL CORPORATION, ANAHEIM, CALIFORNIA, LIFE SCIENCES OPERATIONS. WATER RESERVOIR SYSTEMS. W70-03435	04A	CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB. ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT, W70-03428	05G
BAFFA (JOHN J.), NEW YORK. INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y., W70-03249	04B	CALIFORNIA UNIV., DAVIS. DEPT. OF ZOOLOGY AND CALIFORNIA STATE DEPT. OF FISH AND GAME, SAN FRANCISCO. THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM, W70-03624	05C
BATTELLE-NORTHWEST, RICHLAND, WASH. EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE, W70-03612	05D	CALIFORNIA UNIV., DAVIS. DEPT. OF ZOOLOGY. I. PRODUCTIVITY PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA, W70-03508	05C
BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB. AND KAISER ALUMINUM AND CHEMICAL CORP., SPOKANE, WASH. POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND, W70-03365	08G	HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA, W70-03551	05A
BFCHTEL CORP., SAN FRANCISCO, CALIF. THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR, W70-03542	05D	CALIFORNIA UNIV., LOS ANGELES. SOCIAL BENEFIT VERSUS TECHNOLOGICAL RISK, W70-03377	06B
BELGRADE UNIV. (YUGOSLAVIA) AND WASHINGTON UNIV., ST. LOUIS, MO. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING. MEASUREMENT OF PHOSPHORUS IN WASTEWATERS, W70-03331	05A	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, ST. CLUD (FRANCE). VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA, W70-03461	02C
BOOZ-ALLEN AND HAMILTON, INC., WASHINGTON, D.C. ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS. W70-03611	06B	CENTRO ELETROTECNICO SPERIMENTALE ITALIANO, MILAN. ASSESSING OUTDOOR INSULATION, W70-03368	08C
BRITISH COLUMBIA UNIV., VANCOUVER. INST. OF FISHERIES. SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION, W70-03328	02H	CESKOSLOVENSKA AKADEMIE VED, PRAGUE. HYDROBIOLOGICAL STATION. HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, PH AND WATER MOVEMENTS IN SLAPY RESERVOIR (1958-1960), W70-03541	02H
BUREAU D'ETUDES DE LA TERRE ARMEE, PARIS (FRANCE). THE PRINCIPLE OF REINFORCED EARTH, W70-03359	08D	CHALMERS UNIV. OF TECHNOLOGY, GOTEBORG (SWEDEN). HYDRAULICS DIV. JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY, W70-03555	08B
BUREAU OF COMMERCIAL FISHERIES, GULF BREEZE, FLA. BIOLOGICAL LAB. INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS, W70-03621	05C	CHICAGO UNIV., ILL. CENTER FOR URBAN STUDIES AND BAUER ENGINEERING, INC., CHICAGO, ILL. A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES,	
BUREAU OF COMMERCIAL FISHERIES, GULF BREEZE, FLA. AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS, W70-03622	05C		
BUREAU OF RECLAMATION, BOISE, IDAHO. ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND			

ORGANIZATIONAL INDEX

W70-03346	05D	DURHAM UNIV. (ENGLAND). DEPT. OF GEOLOGY.
CLEMSON UNIV., S.C. DEPT. OF ENVIRONMENTAL SYSTEMS ENGINEERING.		DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES,
AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT,		W70-03285
W70-03619	05G	02J
CLEMSON UNIV., S.C. WATER RESOURCES RESEARCH INST. EVALUATION AND APPLICATION OF A DIGITAL HYDROLOGIC SIMULATION MODEL,	02A	EASTERN NEW MEXICO UNIV., PORTALES. DEPT. OF BIOLOGICAL SCIENCES.
W70-03436		CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO,
COAST AND GEODETIC SURVEY, ROCKVILLE, MD.	07B	RUNOFF FLOWAGE,
A RAINFALL RATE SENSOR,		W70-03501
W70-03363		05B
CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS,	02L	FEDERAL POWER COMMISSION, WASHINGTON, D.C.
W70-03476		MULTIPLE USE OF RIGHTS OF WAY A CHALLENGE TO THE FASST,
COLLEGE OF ENGINEERING, MADRAS (INDIA).		W70-03376
A NONLINEAR APPROACH TO BUNOFF STUDIES,	02A	08C
W70-03290		FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CORVALLIS, OREG. PACIFIC NORTHWEST WATER LAB.
COLORADO STATE UNIV., FORT COLLINS.		THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT,
CONFERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY,		W70-03512
W70-03256	07C	05C
COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.		FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, EDISON, N.J.
COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION,		NORTHEAST REGION RESEARCH AND DEVELOPMENT PROGRAM.
W70-03295	02E	CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.
A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY,	02A	W70-03349
W70-03301		05C
STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,	02E	FISHERIES RESEARCH BOARD OF CANADA, DARTMOUTH (NOVA SCOTIA).
W70-03497		BEDFORD INST. LAB.
COLORADO STATE UNIV., FORT COLLINS. DEPT. OF GEOLOGY AND GEOLOGICAL SURVEY, FORT COLLINS, COLO.		THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION,
PALEOHYDROLOGY APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST,	02A	W70-03313
W70-03490		02K
COMMISSIONER OF PARKS AND PUBLIC PROPERTY, CEDAR RAPIDS, IOWA.		FISHERIES RESEARCH BOARD OF CANADA, DARTMOUTH (NOVA SCOTIA).
THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,	06P	BEDFORD INST.
W70-03342		OCCURRENCE AND SIGNIFICANCE OF IRON, MANGANESE, AND TITANIUM IN GLACIAL MARINE SEDIMENTS FROM THE ESTUARY OF THE ST LAWRENCE RIVER,
COMMITTEE FOR ENVIRONMENTAL INFORMATION, ST. LOUIS, MO.	05B	W70-03320
POISONING THE WELLS.		02K
W70-03276		FOOD AND DRUG ADMINISTRATION, WASHINGTON, D.C. DIV. CF MICROBIOLOGY.
A NEW POLLUTION PROBLEM,	05B	THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, ARTEMIA SALINA,
W70-03456		W70-03528
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ST. LUCIA (AUSTRALIA).		05C
CUNNINGHAM LAB.		FOREST SERVICE (USDA), BEECH, KY. NORTHEASTERN FOREST EXPERIMENTAL STATION.
DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,		DETERMINING PH OF STRIP-MINE SPOILS,
W70-03502	05A	W70-03281
CORNELL UNIV. ITHACA, N.Y.		05A
THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,	02G	GENERAL AMERICAN TRANSPORTATION CORP., MILES, ILL.
W70-03495		MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,
CORPS OF ENGINEERS, BUFFALO, N.Y.		W70-03610
FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.	04A	05G
W70-03261		GEOLOGICAL SURVEY OF ISRAEL, JERUSALEM. HYDROGEOLOGICAL DIV.
CORPS OF ENGINEERS, JACKSONVILLE, FLA.		HYDROGEOLOGY OF A VOLCANIC ISLAND CHE JU DO, KOREA,
FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.		W70-03258
W70-03273	04A	02F
CORPS OF ENGINEERS, SEATTLE, WASH.		GEOLOGICAL SURVEY, AUSTIN, TEX.
FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.		RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS,
W70-03272	04A	W70-03459
CORPS OF ENGINEERS, WASHINGTON, D.C. COMMITTEE ON CHANNEL STABILIZATION.		02F
EFFECT OF WATER TEMPERATURE ON DISCHARGE AND BED CONFIGURATION, MISSISSIPPI RIVER AT RED RIVER LANDING, LOUISIANA,		BASE-FLOW STUDIES OF LEON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968,
W70-03552	05C	W70-03466
CROWN ZELLERBACH CORP., CAMAS, WASH.		02E
AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN,		HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, BRAZOS RIVER BASIN, TEXAS, 1955-64,
W70-03625	05G	W70-03467
DALHOUSIE UNIV., HALIFAX (NOVA SCOTIA). INST. OF OCEANOGRAPHY AND WASHINGTON UNIV., SEATTLE. DEPT. OF OCEANOGRAPHY.		02E
DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS,		GEOLOGICAL SURVEY, BOISE, IDAHO.
W70-03503	05B	HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO,
DEPARTMENT OF ENERGY, MINES AND RESOURCES, TORONTO (ONTARIO). CONSERVATION AUTHORITIES BRANCH.		W70-03254
FLOW ROUTING BY DIRECT INTEGRATION METHOD,		02F
W70-03294	02E	GEOLOGICAL SURVEY, COLUMBIA, S.C.
DEPARTMENT OF JUSTICE, WASHINGTON, D.C.		QUALITY OF SURFACE WATERS OF SOUTH CAROLINA A SUMMARY OF DATA, 1945-1968,
THE FEDERAL VIEW OF DAMAGES AND BENEFITS,		W70-03266
W70-03361	06E	05B
DIALOGUE, 1970, NO. 1.		GEOLOGICAL SURVEY, DENVER, COLO.
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS,
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		W70-03375
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		08H
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		GEOLOGICAL SURVEY, HARRISBURG, PA.
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA),
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		W70-03458
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		02E
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		GEOLOGICAL SURVEY, PHOENIX, ARIZ.
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		GROUNDWATER CONDITIONS IN THE RANEGAS PLAIN, YUMA COUNTY, ARIZONA,
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		W70-03267
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		04B
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		GEOLOGICAL SURVEY, SALT LAKE CITY, UTAH.
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		GREAT SALT LAKE, UTAH CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966,
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		W70-03279
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		02H
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		GEOLOGICAL SURVEY, TALLAHASSEE, FLA.
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE EICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		W70-03260
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		05C
DISCUSSIONS ON THE USE OF GROUNDWATER IN THE DETERMINATION OF THE QUALITY OF SURFACE WATERS.		TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DADE COUNTY,

ORGANIZATIONAL INDEX

GEO-MIC

FLORIDA, W70-03268	02L	W70-03448	08E
WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66, W70-03443	02F	INSTITUTE FOR WATER RESOURCES RESEARCH, BERLIN (EAST GERMANY).	
GEOLOGICAL SURVEY, TUCSON, ARIZ. AND BUREAU OF RECLAMATION, PHOENIX, ARIZ.		THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION, W70-03292	02A
MINERAL AND WATER RESOURCES OF ARIZONA PART 2. WATER RESOURCES AND PART 3. WATER RESOURCE DEVELOPMENT, W70-03278	02E	IOWA UNIV., IOWA CITY. DEPT. OF MECHANICS AND HYDRAULICS. STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE, W70-03260	08B
GEOLOGICAL SURVEY, WASHINGTON, D.C. LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES, W70-03255	02E	JOHN HOPKINS UNIV., BALTIMORE, MD. CHESAPEAKE BAY INST. ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY, W70-03259	02L
MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS, W70-03280	02E	KANSAS WATER RESOURCES RESEARCH INST., MANHATTAN. OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS, W70-03614	05D
GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA, W70-03306	02F	KIEL UNIV. (GERMANY). GEOLOGICAL INST. INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE, W70-03284	02L
GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL MINNESOTA, W70-03477	02F	KONINKLIJKE-SHELL EXPLORATIE EN PRODUKTIE LABORATORIUM, RIJSWIJK (NETHERLANDS). AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS, W70-03282	02J
GEOLOGICAL SURVEY, WASHINGTON, D.C. OFFICE OF WATER DATA COORDINATION.		KYOTO UNIV. (JAPAN). DISASTERS PREVENTION RESEARCH INST. A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES, W70-03305	02A
CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS, W70-03473	07C	ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS, W70-03489	02A
GEOLOGICAL SURVEY, WASHINGTON, D.C. WATER RESOURCES DIV. WATER AND MAN A WORLD VIEW, W70-03450	06G	KYOTO UNIV. (JAPAN). OTSU HYDROBIOLOGICAL STATION. STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM, W70-03319	02H
ARROGANCE TOWARD THE LANDSCAPE A PROBLEM IN WATER PLANNING, W70-03465	06G	LAKEHEAD UNIV., PORT ARTHUR (ONTARIO). A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHES, LAKE SUPERIOR, ONTARIO, W70-03472	02H
GEOLOGICAL SURVEY, WORLAND, WYO. SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA, W70-03457	02J	LAMONT-DOEHERTY GEOLOGICAL OBSERVATORY, PALISADES, N.Y. NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN, W70-03463	02L
GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING. THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION, W70-03617	02J	LINCOLN CITY-LANCASTER COUNTY PLANNING COMMISSION, NEBR. LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT, W70-03341	06F
GEORGIA KRAFT CO., ROME. RESEARCH AND DEVELOPMENT CENTER. FOAM SEPARATION OF KRAFT PULPING WASTES. W70-03350	05D	LOUISIANA STATE UNIV., BATON ROUGE. HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN, W70-03445	02J
GEORGIA UNIV., SAPELO ISLAND. MARINE INST. X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS, W70-03286	02J	MACHINE DESIGN, CLEVELAND, OHIO. NONDESTRUCTIVE TESTING, W70-03356	07B
GRUZINSKII FOLITEKHNIKESKII INSTITUT, TIFLIS (USSR). RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING, W70-03304	02A	MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM, PLYMOUTH (ENGLAND). LAB. THE EFFECTS OF OIL-SPILL REMOVERS ("DETERGENTS") ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY, W70-03513	05C
GULF RESEARCH AND DEVELOPMENT CO., PITTSBURGH, PA. PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING, W70-03287	02J	MARYLAND UNIV., COLLEGE PARK. DEPT. OF CIVIL ENGINEERING AND FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D.C. NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION, W70-03265	05A
HARVARD UNIV., CAMBRIDGE, MASS. DEPT. OF APPLIED CHEMISTRY. OXYGENATION OF FERROUS IRON THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE, W70-03434	05B	MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF ECONOMICS AND MASSACHUSETTS INST. OF TECH., CAMBRIDGE. ALFRED P. SLOAN SCHOOL OF MANAGEMENT. REVIEW AND ANALYSIS OF THE COSTS OF DESALTING SEA WATER, W70-03453	03A
HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER. SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII, W70-03613	02A	MELBOURNE UNIV., PARKVILLE (AUSTRALIA). DEPT. OF AGRICULTURAL ENGINEERING. THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW, W70-03492	02A
HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER. IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE WATER QUALITY, W70-03430	05B	MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF PHYSIOLOGY. RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GIRDNERI) TO STRESS, W70-03527	05C
HEIDELBERG UNIV., (WEST GERMANY). SEDIMENT RESEARCH LAB. SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRIAL CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ("SALT LAKE"), TURKEY, W70-03446	02J	MICHIGAN STATE UNIV., HICKORY CORNERS. W. K. KELLOGG BIOLOGICAL STATION. FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD- WATER LAKES, W70-03307	02H
IDARO UNIV., MOSCOW. WATER RESOURCES RESEARCH INST. A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO, W70-03645	02B	MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING. INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES, W70-03348	06B
ILLINOIS STATE SANITARY WATER BOARD, SPRINGFIELD. LAKE MICHIGAN BEACH SURVEY 1968. W70-03339	05C	MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL HEALTH. UPTAKE AND RETENTION OF MALATHION BY THE CARP,	
ILLINOIS UNIV., URBANA AND INDIANA UNIV., BLOOMINGTON. TEXTURAL STUDIES OF GRADING VOLCANIC ASH FALLS, W70-03288	02J		
ILLINOIS UNIV., URBANA. BRANCHING-TYPE MODELS OF FLOW THROUGH POROUS MEDIA, W70-03262	02F		
ILLINOIS UNIV., URBANA. DEPT. OF GEOLOGY. CONSOLIDATION AND SEDIMENTATION-COMPRESION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS,			

ORGANIZATIONAL INDEX

W70-03516	05C	UNIV., CHAPEL HILL. PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL. W70-03439	05G
THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF HALATHON TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS). RAPINESQUE), W70-03518	05C	NORTH CAROLINA WATER RESOURCES RESEARCH INST., RALEIGH. NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA, W70-03351	05A
MICHIGAN UNIV., ANN ARBOR. DEPT. OF METEOROLOGY AND OCEANOGRAPHY AND NORTHERN MICHIGAN UNIV., MARQUETTE. LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS, W70-03451	01B	THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT, W70-03616	06B
MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, LONDON (ENGLAND). SALMON AND FRESHWATER FISHERIES LAB. SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT SALMO GAIRDNERI RICHARDSON, W70-03522	05C	NORTH DAKOTA UNIV., GRAND FORKS. SCHOOL OF MEDICINE. MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES ON LAGOON ECOLOGY, W70-03312	05C
THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-03524	05C	NORTH TEXAS STATE UNIV., DENTON. DEPT. OF BIOLOGY. EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE, W70-03519	05C
SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES, W70-03623	05C	BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE, W70-03520	05C
MINNESOTA UNIV., MINNEAPOLIS. SCHOOL OF PUBLIC HEALTH AND MINNESOTA UNIV., DULUTH. DEPT. OF BIOLOGY. LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR, W70-03329	02H	NORTHEASTERN UNIV., BOSTON, MASS. DEPT. OF CIVIL ENGINEERING. USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES, W70-03488	05B
MINNESOTA UNIV., MINNEAPOLIS. SCHOOL OF PUBLIC HEALTH. A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR, W70-03311	02H	OFFICE OF THE CHIEF OF ENGINEERS (ARMY), WASHINGTON, D.C. FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH, W70-03340	06B
MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB. HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS, W70-03540	05B	OHIO STATE UNIV., COLUMBUS. DEPT. OF MICROBIOLOGY AND OHIO STATE UNIV., COLUMBUS. AQUATIC BIOLOGY LAB. PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA, W70-03505	05B
MINNESOTA UNIV., MINNEAPOLIS. WATER RESOURCES RESEARCH CENTER. PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDED, W70-03506	02H	OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ENGINEERING. THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL, W70-03475	02E
MONTANA STATE UNIV., BOZEMAN. WATER RESOURCES RESEARCH CENTER. THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM, W70-03615	07A	ONTARIO WATER RESOURCES COMMISSION, TORONTO. GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA, W70-03253	05B
MONTANA UNIV., MISSOULA. SCHOOL OF FORESTRY AND MONTANA UNIV., MISSOULA. DEPT. OF CHEMISTRY. ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIOIODINE ABSORPTION, W70-03626	02I	OREGON STATE UNIV., CORVALLIS. STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR, W70-03543	05B
NATAL UNIV., DURBAN (SOUTH AFRICA). A NEW RECORDING TURBIDITY METER FOR RIVERS, W70-03277	07B	OREGON STATE UNIV., CORVALLIS. DEPT. OF BOTANY. A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS, W70-03252	05C
NATIONAL FORESTS, PARKS AND DEVELOPMENT PROJECTS. W70-03598	06E	OREGON STATE UNIV., CORVALLIS. DEPT. OF FISHERIES AND WILDLIFE. ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS, W70-03525	05C
NATIONAL RESEARCH CENTER, CAIRO (EGYPT). EARTH SCIENCE LAB. GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R., W70-03469	02L	OREGON STATE UNIV., CORVALLIS. PACIFIC COOPERATIVE WATER POLLUTION AND FISHERIES RESEARCH LABS. LABORATORY STUDIES OF PERiphyton PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS, W70-03327	05C
NAVAL OCEANOGRAPHIC OFFICE, WASHINGTON, D.C. DEEP VEHICLES BRANCH. VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE BLAKE PLATEAU, W70-03462	02J	PITTSBURGH UNIV., PA. DEPT. OF BIOLOGICAL SCIENCES. NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA, W70-03511	05C
NEBRASKA UNIV., LINCOLN. WATER RESOURCES RESEARCH INST. SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES, W70-03646	03A	PITTSBURGH UNIV., PA. DEPT. OF CIVIL ENGINEERING. REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA, W70-03263	07C
NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF ZOOLOGY. REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SUBLETHAL CONCENTRATIONS OF DDT, W70-03515	05C	POMEBOY, JOHNSTON AND BAILEY, PASADENA, CALIF. HYDROGEN SULFIDE ODOR THRESHOLD, W70-03275	05A
NEW SOUTH WALES UNIV., KENSINGTON (AUSTRALIA). AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION, W70-03291	02A	PUERTO RICO UNIV., MAYAGUEZ. DEPT. OF AGRICULTURAL ECONOMICS. THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO, W70-03246	04A
NEW YORK STATE DEPT. OF CONSERVATION, ALBANY. DIV. OF MARINE AND COASTAL RESOURCES. FISH AND POWER PLANTS, W70-03250	05C	PUERTO RICO UNIV., MAYAGUEZ. SCHOOL OF ENGINEERING. THE WATER RESOURCES SITUATION IN PUERTO RICO AN EVALUATION OF PUBLISHED INFORMATION, W70-03245	06B
NORTH CAROLINA STATE UNIV., RALEIGH. DEPT. OF CHEMICAL ENGINEERING. POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION GRAFTING TO LIGNIN AND LIGNIN-CONTAINING POLYS, W70-03438	05G	DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES, W70-03247	06D
NORTH CAROLINA STATE UNIV., RALEIGH. PESTICIDE RESIDUE RESEARCH LAB. A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA, W70-03437	05B	PURDUE UNIV., LAFAYETTE, IND. DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS, W70-03354	08G
NORTH CAROLINA WATER RESOURCES RESEARCH INST., RALEIGH AND NORTH CAROLINA STATE UNIV., RALEIGH		RENSSELAER POLYTECHNIC INST., TROY, N.Y. DEPT. OF GEOLOGY. THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS, W70-03468	02K
NORTH CAROLINA STATE UNIV., RALEIGH AND NORTH CAROLINA		RENSSELAER POLYTECHNIC INST., TROY, N.Y. DEPT. OF GEOLOGY. A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS, W70-03470	07B

ORGANIZATIONAL INDEX

RES-WAS

RESEARCH INST. FOR WATER RESOURCES DEVELOPMENT, BUDAPEST
(HUNGARY). KARSTIC WATER RESEARCH SECTION.
KARSTIC WATER RESEARCH IN HUNGARY,
W70-03264 02F

RICE (CYRUS WM.) AND CO., PITTSBURGH, PA.
THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES,
W70-03431 06C

COST HANDBOOK FOR INDUSTRIAL WATER USES,
W70-03432 06C

RIJKSINSTITUT VOOR ZUIVERING VAN AFVALWATER, VOORBURG
(NETHERLANDS).
WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER
(DUTCH),
W70-03269 05B

SARGENT AND LUNDY, CHICAGO, ILL.
WATER SUPPLY TO THERMAL POWER PLANTS,
W70-03458 03E

SCRIPPS INSTITUTION OF OCEANOGRAPHY, LA JOLLA, CALIF.
ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE,
W70-03335 05C

SHELL OIL CO., DENVER, COLO. ROCKY MOUNTAIN DIV. AND
COLORADO STATE UNIV., FORT COLLINS. DEPT. OF AGRICULTURAL
AND IRRIGATION ENGINEERING.
SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA,
W70-03297 02F

SOUTHWESTERN RADIOLOGICAL HEALTH LAB., LAS VEGAS, NEV.
CPPSITE RADIODILOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE
1967-JULY 1968,
W70-03452 05A

STANFORD UNIV., CALIF.
MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW,
W70-03455 02G

STANFORD UNIV., CALIF. DEPT. OF CIVIL ENGINEERING.
THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC
TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,
W70-03296 02A

STATE WATER PLAN DEVELOPMENT OF WATER RESOURCES MANAGEMENT,
PRAGUE (CZECHOSLOVAKIA).
SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
W70-03496 02A

TECHNISCHE HOCHSCHULE, AACHEN (WEST GERMANY).
EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS,
W70-03547 05C

TECHNISCHE UNIVERSITAET, BERLIN (WEST GERMANY). INST. OF
GEOLOGY AND PALEONTOLOGY.
STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN
FINE-GRAINED CARBONATE ROCKS,
W70-03447 02J

TENNESSEE UNIV., TULLahoma. SPACE INST. AND WESTINGHOUSE
ELECTRIC CORP., PITTSBURGH, PA. RESEARCH AND DEVELOPMENT
CENTER.
HRD POWER GENERATION CURRENT STATUS,
W70-03374 08C

TENNESSEE VALLEY AUTHORITY, NORRIS.
WATER TEMPERATURE AND SPRING FISHING, NORRIS RESERVOIR,
TENNESSEE,
W70-03559 05C

TENNESSEE VALLEY AUTHORITY, NORRIS. ENGINEERING LAB.
UNIVERSAL FORMULA FOR UNIPOEM FLOW,
W70-03248 08B

TENNESSEE VALLEY AUTHORITY, NORRIS. FISH AND WILDLIFE
BRANCH.
EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH
PRODUCTION IN NORRIS RESERVOIR, TENNESSEE,
W70-03317 02R

TERMINAL AND DISPLAY SYSTEMS, INC.
BUILDING A COMPUTER-BASED MIS,
W70-03360 10

TEXAS A AND M UNIV., COLLEGE STATION. DEPT. OF METEOROLOGY.
RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS,
W70-03479 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART A. RAINFALL PATTERNS IN GUAYANA
AND SURINAM,
W70-03480 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART B. MOVEMENT OF MESOSCALE SYSTEMS
IN COLOMBIA,
W70-03481 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART C. DAILY RAINFALL IN INTERIOR
COLOMBIA,
W70-03482 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART D. NORMALITY OF RAINFALL
DISTRIBUTIONS,
W70-03483 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART E. EXTREME VALUE ANALYSIS IN
VENEZUELA,
W70-03484 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART F. TRENDS IN THE RAINFALL,
W70-03485 02B

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED
MESOSCALE SYSTEMS PART H. AN ANALYSIS OF THE DISTRIBUTION
OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED
STATIONS IN WESTERN COLOMBIA,
W70-03486 02B

TEXAS INSTRUMENTS, INC., DALLAS AND KANSAS UNIV., LAWRENCE.
DEPT. OF CIVIL ENGINEERING.
IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO,
W70-03471 02J

TEXAS WATER DEVELOPMENT BOARD, AUSTIN.
OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY,
TEXAS,
W70-03460 02F

TOHOKU UNIV., SENDAI (JAPAN). HYDRAULIC ENGINEERING LAB.
FLOOD FORECASTING IN THE RIVER KITAKAMI,
W70-03293 02A

TOKYO UNIV. (JAPAN). GEOGRAPHICAL INST.
CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN,
W70-03316 02H

TORONTO UNIV. (ONTARIO). DEPT. OF ZOOLOGY AND FISHERIES
RESEARCH BOARD OF CANADA, WINNIPEG (MANITOBA).
COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT
LAKES,
W70-03315 02H

TORONTO UNIV. (ONTARIO) AND DEPARTMENT OF LANDS AND FORESTS
(ONTARIO).
FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO,
W70-03323 02H

TORONTO UNIV. (ONTARIO). EFFECT OF HEAT ON THE LIGHT BEHAVIOR OF FISH,
W70-03558 05C

TORONTO UNIV. (ONTARIO). DEPT. OF GEOLOGY AND WISCONSIN
UNIV., MADISON. DEPT. OF GEOLOGY AND GEOPHYSICS.
THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA,
WISCONSIN,
W70-03504 05B

TORONTO UNIV. (ONTARIO). DEPT. OF MECHANICAL ENGINEERING.
RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL
INPUT,
W70-03498 04A

TORONTO UNIV. (ONTARIO). DEPT. OF ZOOLOGY.
AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE
RAINBOW TROUT, SALMO GAIRDNERI RICHARDSON,
W70-03554 05C

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG (SOUTH
AFRICA). DEPT. OF ZOOLOGY.
TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETEBS) IN A
TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT,
W70-03556 05C

UPPSALA UNIV. (SWEDEN). INST. OF LIMNOLOGY.
LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED
SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET,
W70-03322 02H

PRESIDENT'S LECTURE LIMNOLOGY, SOCIAL WELFARE, AND LAKE
KINNEFJET,
W70-03509 02H

UTAH UNIV., SALT LAKE CITY. DEPT. OF GEOLOGICAL AND
GEOPHYSICAL SCIENCES.
RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR
ESCALANTE, GARFIELD COUNTY, UTAH,
W70-03454 02P

UTRECHT RIJKSUNIVERSITEIT (NETHERLANDS). GEOLOGICAL INST.
AND STATE GEOLOGICAL SURVEY, HAARLEM (NETHERLANDS).
INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA
RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER-
POINTBAR DEPOSITS, LOWER RHINE),
W70-03289 02J

VANDERBILT UNIV., NASHVILLE, TENN. DEPT. OF ENVIRONMENTAL
AND WATER RESOURCES ENGINEERING.
THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE
ASSIMILATIVE CAPACITY,
W70-03550 05C

VIRGINIA POLYTECHNIC INST., BLACKSBURG. WATER RESOURCES
RESEARCH CENTER.
SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN
WITH SPECIAL EMPHASIS ON TEMPERATURE,
W70-03244 05C

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF ZOOLOGY.
ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING
RADIATION - A SELECTED BIBLIOGRAPHY,
W70-03308 07B

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.

ORGANIZATIONAL INDEX

CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT, W70-03433	05D	W70-03507	05C
WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY. ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM, W70-03309	05C	WISCONSIN UNIV., MADISON. DEPT. OF ENTOMOLOGY. ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES, W70-03333	02H
WASHINGTON UNIV., SEATTLE. LAB. OF RADIATION ECOLOGY. EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRATE AND FIN RAYS IN YOUNG CHINOOK SALMON, W70-03557	05C	WISCONSIN UNIV., MADISON. DEPT. OF SOIL SCIENCE. ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION, W70-03449	02D
WATERLOO UNIV (ONTARIO). VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS, W70-03303	07C	WISCONSIN UNIV., MADISON. WATER RESOURCES CENTER. FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS, W70-03353	05D
WATERLOOPUNDIG LABORATORIUM, DELFT (NETHERLANDS). ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS, W70-03545	08B	BIOLOGICAL N ₂ FIXATION IN LAKES, W70-03429	05C
WESTERN FISH DISEASE LAB., SEATTLE, WASH. SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TINSAN), W70-03523	05C	WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS. EDGARDO BALDI MEMORIAL LECTURE CURRENT CONCEPTS IN AQUATIC MICROBIOLOGY, W70-03510	05C
WISCONSIN UNIV., MADISON. DEPT. OF BOTANY. CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE, W70-03310	05G	WORCESTER POLYTECHNIC INST., MASS. USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES, W70-03509	05B
THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,		WRIGHT-MCLAUGHLIN ENGINEERS, DENVER, COLO. MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL, W70-03343	04C
		YALE UNIV., NEW HAVEN, CONN. EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER, W70-03464	02C

ACCESSION NUMBER INDEX

05C	W70-03244	05C	W70-03325	06E	W70-03407	05B	W70-03488
06B	W70-03245	05C	W70-03326	06E	W70-03408	02A	W70-03489
04A	W70-03246	05C	W70-03327	06E	W70-03409	02A	W70-03490
06D	W70-03247	02H	W70-03328	06E	W70-03410	03B	W70-03491
08B	W70-03248	02H	W70-03329	06E	W70-03411	02A	W70-03492
04B	W70-03249	04A	W70-03330	06E	W70-03412	02G	W70-03493
05C	W70-03250	05A	W70-03331	04A	W70-03413	02G	W70-03495
05D	W70-03251	02H	W70-03332	06E	W70-03414	02A	W70-03496
05C	W70-03252	02H	W70-03333	05G	W70-03415	02E	W70-03497
05B	W70-03253	05D	W70-03334	04A	W70-03416	04A	W70-03498
02F	W70-03254	05C	W70-03335	06E	W70-03417	04A	W70-03499
02E	W70-03255	05C	W70-03336	06E	W70-03418	02L	W70-03500
07C	W70-03256	04A	W70-03337	04A	W70-03419	05B	W70-03501
04B	W70-03257	06B	W70-03338	05G	W70-03420	05A	W70-03502
02F	W70-03258	05C	W70-03339	06B	W70-03421	05B	W70-03503
02L	W70-03259	06B	W70-03340	06B	W70-03422	05B	W70-03504
05C	W70-03260	06F	W70-03341	06E	W70-03423	05B	W70-03505
04A	W70-03261	06F	W70-03342	04B	W70-03424	02H	W70-03506
02F	W70-03262	04C	W70-03343	08G	W70-03425	05C	W70-03507
07C	W70-03263	05E	W70-03344	06E	W70-03426	05C	W70-03508
02F	W70-03264	05G	W70-03345	06E	W70-03427	02H	W70-03509
05A	W70-03265	05D	W70-03346	05G	W70-03428	05C	W70-03510
05B	W70-03266	04A	W70-03347	05C	W70-03429	05C	W70-03511
04B	W70-03267	06B	W70-03348	05B	W70-03430	05C	W70-03512
02L	W70-03268	05C	W70-03349	06C	W70-03431	05C	W70-03513
05B	W70-03269	05D	W70-03350	06C	W70-03432	04A	W70-03514
05D	W70-03270	05A	W70-03351	05D	W70-03433	05C	W70-03515
05G	W70-03271	05D	W70-03353	05B	W70-03434	05C	W70-03516
04A	W70-03272	08G	W70-03354	04A	W70-03435	06D	W70-03517
04A	W70-03273	08C	W70-03355	02A	W70-03436	05C	W70-03518
02F	W70-03274	07B	W70-03356	05B	W70-03437	05C	W70-03519
05A	W70-03275	04A	W70-03357	05G	W70-03438	05C	W70-03520
05B	W70-03276	08C	W70-03358	05G	W70-03439	04A	W70-03521
07B	W70-03277	08D	W70-03359	05F	W70-03440	05C	W70-03522
02E	W70-03278	10	W70-03360	02B	W70-03441	05C	W70-03523
02H	W70-03279	06E	W70-03361	05E	W70-03442	05C	W70-03524
02E	W70-03280	08H	W70-03362	02F	W70-03443	05C	W70-03525
05A	W70-03281	07B	W70-03363	04A	W70-03444	05C	W70-03526
02J	W70-03282	05G	W70-03364	02J	W70-03445	05C	W70-03527
02J	W70-03283	08G	W70-03365	02J	W70-03446	05C	W70-03528
02L	W70-03284	08C	W70-03366	02J	W70-03447	04A	W70-03529
02J	W70-03285	08E	W70-03367	08E	W70-03448	05D	W70-03530
02J	W70-03286	08C	W70-03368	02D	W70-03449	05D	W70-03531
02J	W70-03287	08C	W70-03369	06G	W70-03450	05G	W70-03532
02J	W70-03288	08D	W70-03370	01B	W70-03451	04A	W70-03533
02J	W70-03289	08F	W70-03371	05A	W70-03452	05G	W70-03534
02A	W70-03290	08F	W70-03372	03A	W70-03453	05G	W70-03535
02A	W70-03291	08C	W70-03373	02F	W70-03454	04A	W70-03536
02A	W70-03292	08C	W70-03374	02G	W70-03455	05D	W70-03537
02A	W70-03293	08H	W70-03375	05B	W70-03456	04A	W70-03538
02E	W70-03294	08C	W70-03376	02J	W70-03457	05C	W70-03539
02E	W70-03295	06B	W70-03377	02E	W70-03458	05B	W70-03540
02A	W70-03296	05G	W70-03378	02F	W70-03459	02H	W70-03541
02F	W70-03297	05G	W70-03379	02F	W70-03460	05D	W70-03542
04A	W70-03298	06E	W70-03380	02C	W70-03461	08B	W70-03543
06E	W70-03299	06E	W70-03381	02J	W70-03462	08B	W70-03544
04A	W70-03300	06E	W70-03382	02L	W70-03463	08B	W70-03545
02A	W70-03301	06E	W70-03383	02C	W70-03464	05C	W70-03546
04A	W70-03302	06E	W70-03384	06G	W70-03465	05C	W70-03547
07C	W70-03303	06E	W70-03385	02E	W70-03466	03E	W70-03548
02A	W70-03304	06E	W70-03386	02E	W70-03467	05B	W70-03549
02A	W70-03305	06E	W70-03387	02K	W70-03468	05C	W70-03550
02F	W70-03306	06E	W70-03388	02L	W70-03469	05A	W70-03551
02H	W70-03307	06E	W70-03389	07B	W70-03470	05C	W70-03552
07B	W70-03308	06B	W70-03390	02J	W70-03471	08B	W70-03553
05C	W70-03309	06B	W70-03391	02H	W70-03472	05C	W70-03554
05G	W70-03310	06B	W70-03392	07C	W70-03473	08B	W70-03555
02H	W70-03311	06B	W70-03393	07A	W70-03474	05C	W70-03556
05C	W70-03312	06B	W70-03394	02E	W70-03475	05C	W70-03557
02K	W70-03313	04A	W70-03395	02L	W70-03476	05C	W70-03558
05C	W70-03314	04A	W70-03396	02F	W70-03477	05C	W70-03559
02H	W70-03315	03D	W70-03397	02L	W70-03478	08B	W70-03560
02H	W70-03316	05G	W70-03398	02B	W70-03479	05G	W70-03561
02H	W70-03317	05G	W70-03399	02B	W70-03480	04A	W70-03562
02H	W70-03318	05G	W70-03400	02B	W70-03481	06E	W70-03563
02H	W70-03319	04A	W70-03401	02B	W70-03482	04A	W70-03564
02K	W70-03320	04A	W70-03402	02B	W70-03483	04A	W70-03565
04A	W70-03321	04A	W70-03403	02B	W70-03484	04A	W70-03566
02H	W70-03322	04A	W70-03404	02B	W70-03485	04A	W70-03567
02H	W70-03323	04D	W70-03405	02B	W70-03486	04A	W70-03568
02H	W70-03324	04A	W70-03406	02E	W70-03487	04A	W70-03569

ACCESSION NUMBER INDEX

06E	W70-03570	06E	W70-03590	04A	W70-03609	04A	W70-03628
06E	W70-03571	06E	W70-03591	05G	W70-03610	05F	W70-03629
06E	W70-03572	04A	W70-03592	06B	W70-03611	05F	W70-03630
06E	W70-03573	06E	W70-03593	05D	W70-03612	05F	W70-03631
06E	W70-03574	06E	W70-03594	02A	W70-03613	05F	W70-03632
06B	W70-03575	06E	W70-03595	05D	W70-03614	04A	W70-03633
06E	W70-03576	06E	W70-03596	07A	W70-03615	04A	W70-03634
06B	W70-03577	06E	W70-03597	06B	W70-03616	06E	W70-03635
P6B	W70-03578	06E	W70-03598	02J	W70-03617	06E	W70-03636
06E	W70-03579	06E	W70-03599	04A	W70-03618	06E	W70-03637
04A	W70-03580	06E	W70-03600	05G	W70-03619	06E	W70-03638
04A	W70-03581	06E	W70-03601	0BB	W70-03620	06E	W70-03639
04A	W70-03582	06E	W70-03602	05C	W70-03621	06E	W70-03640
04A	W70-03583	04A	W70-03603	05C	W70-03622	06E	W70-03641
04A	W70-03584	04A	W70-03604	05C	W70-03623	06E	W70-03642
04A	W70-03585	06E	W70-03605	05C	W70-03624	04A	W70-03643
06E	W70-03586	04A	W70-03606	05G	W70-03625	05G	W70-03644
06E	W70-03587	06E	W70-03607	02I	W70-03626	02B	W70-03645
06E	W70-03588	06E	W70-03608	06E	W70-03627	03A	W70-03646

ABSTRACT SOURCES

Source	Accession No.	Total
A. Center of Competence		
U.S. Geological Survey - Hydrology	W70-03244 -- 03297 03301, 03303 -- 03306 03440 -- 03443 03446 -- 03490 03492 -- 03498 03500	116
University of Wisconsin - Eutrophication	W70-03307 -- 03320 03322 -- 03329 03331 -- 03336 03501 -- 03512	40
University of Chicago - Metropolitan Water Resources Management	W70-03338 -- 03343 03346, 03348	8
Bureau of Reclamation - Engineering Works	W70-03354 -- 03377	24
University of Florida - Eastern U.S. Water Law	W70-03378 -- 03427 03561 -- 03609 03627 -- 03644 03298, 03299, 03300, 03302, 03321, 03330, 03337, 03344, 03345, 03444, 03435, 03347, 03491, 03499, 03514, 03517, 03521, 03529, 03532, 03533, 03534, 03535, 03536, 03538, 03618	141
University of Washington - Water Quality Requirements for Aquatic Organisms	W70-03512 -- 03513 03315 -- 03516 03518 -- 03528 03621 -- 03624	18
North Carolina State University - Textile Wastes	W70-03530 -- 03531 03537 -- 03538	4
Vanderbilt University - Thermal Pollution	W70-03539 -- 03560	22
Cornell University - Policy Models for Water Resources Systems	W70-03619	1
B. Others:		
Federal Water Pollution Control Administration	W70-03349 -- 03350 03610, 03611, 03612, 03428, 03433	7
North Carolina Water Resources Research Institute	W70-03351, 03437 -- 03439 03616	5
Georgia Water Resources Center	W70-03617	1
Wisconsin Water Resources Center	W70-03353, 03429	2

ABSTRACT SOURCES

Source	Accession No.	Total
Hawaii Water Resources Research Center	W70-03430, 03613	2
Office of Water Resources Research (NUS Corporation)	W70-03431 -- 03432	2
South Carolina Water Resources Research Institute	W70-03436	1
Kansas Water Resources Research Institute	W70-03614	1
Montana Water Resources Research Center	W70-03615, 03626	2
Iowa State Water Resources Research Institute	W70-03620	1
New Jersey Water Resources Research Institute	W70-03625	1

Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 0 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSION NUMBER INDEX
- ABSTRACT SOURCES

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